final environmental impact statement

U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

CRUDE OIL TRANSPORTATION SYSTEM: VALDEZ, ALASKA TO MIDLAND, TEXAS

(AS PROPOSED BY SOHIO TRANSPORTATION COMPANY)

CHAPTERS 3 THROUGH 7
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION
MITIGATING MEASURES
ADVERSE IMPACTS THAT CANNOT BE AVOIDED
SHORT-TERM USES AND LONG-TERM PRODUCTIVITY
IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS
OF RESOURCES

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ENVIRONMENTAL STATEMENT

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Prepared by

Bureau of Land Management
U.S. Department of the Interior

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CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

3.0 INTRODUCTION AND SUMMARY OF MAJOR IMPACTS

This section summarizes the assumptions and possible environmental impacts presented in the body of the chapter. While some information and impacts identified also were discussed in the Trans-Alaska Pipeline project ES, discussion herein does not imply duplication, but is evidence of further information gained from new studies. For example, in the discussion of Port Valdez impacts under the Sea Leg heading, there is new information on air quality and navigational hazards, among other topics.

The impacts described throughout this chapter also reflect the information available from SOHIO regarding the details of the proposed action. Where planning or design details have not been worked out or finalized, standard operation procedures and conservative assumptions have been the basis for evaluation. This is most evident in consideration of worst-case situations. When this problem of lack of project detail leads to severe worst-case impacts, they are so identified.

Three categories of environmental impacts which would result from the proposed actions appear to be more critical than others also identified. First is the impact upon air quality; second is possible hazard from accidental oil spills; third is aesthetic impact of new transmission lines across stretches of relatively undisturbed desert country.

Air Quality. Potential air quality impacts in Port Valdez are summarized in Section 3.1.6. Impacts appear severe with or without the proposed SOHIO project.

Environmental impacts on air quality in the Los Angeles area result from a variety of sources such as tankers, storage tanks, and construction of new facilities. Various pollutants are involved and include dust, hydrocarbons, oxidants, sulfur dioxide (SO_2), and nitrogen oxides (NOx). Present ambient air quality in Los Angeles is worse than specified in state and Federal standards on most days.

Two types of events, if proposed mitigation is not implemented, could in themselves result in the impossibility of attaining the Federal oxidant air quality standard: ballasting into emptied petroleum tanks on tankers without sufficient exclusive ballast tanks; and, gas-freeing or purging empty tanks on tankers having inert gas systems while in port or coastal waters (contrary to proposed operating procedures).

The applicant is committed to and would need to acquire other emission sources and, by shutting them down, use them as "trade-offs" for new project-oriented emissions. The net result, assuming that mitigating measures are enforced and that "trade-offs," fulfilling EPA interpretive rulings, are made, would be that the proposed action would contribute no net adverse impact on air quality during the operation stage. The incremental adverse impact would then occur only during the period of construction (slightly more than a year), or as a result of an accidental spill of crude oil.

Impact of accidental oil spills. The impacts from an oil spill and the created hazards would impact almost every aspect of the environment affected by the spill. Nearly every resource category of the Statement discusses the damages that would occur from an oil spill. Several types of accidents could result in major impacts. The two most serious would be tanker accidents that result in oil coming ashore and a major pipeline rupture in a stream, such as the Colorado River, or in an earthquake fault zone. Less well known, but perhaps a greater possibility, would be impacts from small leaks in the pipeline that could go undetected for days or weeks. Another hazard is the possibility of small spills from normal operations of loading in Port Valdez and in berthing, off-loading, and transfer areas in the Port of Long Beach.

The area most likely to experience a major oil spill is in the tanker route from Port Valdez through Prince William Sound to the Gulf of Alaska. This impact is associated with trade in Trans-Alaska Pipeline oil and would be severe with or without approval of this proposed project.

New transmission lines in desert areas. The construction of new transmission lines across stretches of relatively undisturbed desert country to supply power to pump stations would directly impact the visual quality of the present environment. Seven of the pump stations would require at least 10 miles of power line to serve them as the project is currently proposed. Two of the pump stations would require 30 miles each in new power-line construction.

Because of a lack of precise information on the location of proposed power-line rights-of-way, these ancillary facilities will require supplemental environmental analysis reports when formal applications from appropriate public utility companies are made. Environmental analyses prepared at the BLM district level would include detailed consideration of impacts and alternative alignments to minimize impacts.

Additional impacts. In addition to the three broad impacts presented above, there are several other impacts affecting the environment.

The six storage tanks proposed for location at Pier J would detract from the present aesthetics of the Long Beach Harbor and appear to be in conflict with the goals of the California Coastal Plan. They would also increase the possibility of exacerbating a major disaster such as fire or explosion. Adverse wildlife impacts are possible if care is not taken in construction, operation, and maintenance of the proposed project. Of particular concern is the possible impact on desert bighorn sheep habitat in the Dome Rock Mountains of western Arizona. Three fish and four bird species presently on the Federal Threatened or Endangered species lists could be affected by the Colorado River pipeline crossing. Should a large oil spill occur in marshes and streams along the pipeline route, the impact on wildlife would be severe.

Additional impacts would include loss of soil productivity through compaction, contamination, and failure to segregate topsoil in cultivated areas. Again, spills of oil or of water used for hydrostatic testing could result in major impacts on soil.

Vegetation along the route would be affected by construction in that natural vegetation areas would be destroyed. Additionally, any oil spill could endanger, and might destroy, some rare plants.

Pipeline and pump station construction could have significant adverse impacts on cultural resources, particularly archaeological resources. Unidentified sites are likely to be encountered at several areas along the route, and destruction of cultural remains is likely.

In determining the cumulative environmental impacts that could occur as a result of this project, projections were made to the year 2000. This time frame was selected on the basis of the estimated life of the project; i.e., transportation of North Slope oil production. Discussions under the Year 2000 heading are hypothesized, based on existing data. Therefore, future conditions could invalidate some of the projections that are under this heading in the following sections.

Impacts of abandonment. Section 1.2.3.5 in Chapter 1 describes the general conditions and procedures under which abandonment of the port and pipeline facilities would occur.

It is expected that at the end of the projected life of the project, or at any other time of discontinued use by the applicant, most, if not all, of the proposed developments and facilities in the Port of Long Beach area would remain intact and would be utilized by other vessels and in other commerce. Exceptions might include the storage tanks and related pipe and valves. Should these be dismantled and salvaged, short-term impacts on traffic flow, noise, and possibly air quality could be expected because of the removal operations. The removal of storage tanks would result in beneficial impacts on visual resources and local air quality and could reduce public safety hazards in the event of fire, explosion, or earthquake.

At the end of the life of this project, the pipeline, pump stations, and related facilities could remain relatively intact or undergo alterations for use in a similar fuel transportation system (such as is proposed for the existing natural gas pipelines). In such a case impacts of abandonment would be minor. Cleaning of the system for conversion or storage could occur as described in Section 1.2.3.5 with resulting impacts of waste water similar to those described for hydrostatic test water disposal in Section 3.1.5.2.1.

Another possibility with project abandonment would be the salvage and removal of most of the pipe, pump stations, and other facilities. Removal of pipe would result in trenching activities within the right-of-way which would adversely impact soils and vegetation which may have partially recovered to their state prior to initial construction. Removal of pump stations, communicaton sites, etc. would result in beneficial impacts on visual resources and local noise levels, and small areas could be allowed to revegetate. If storage tanks at Midland were removed, beneficial impacts on local air quality would occur after short-term adverse impacts on noise levels and possibly air quality due to the dismantling work.

3.1 DIRECT AND INDIRECT IMPACTS CONVERSION, CONSTRUCTION, OPERATION

3.1.1 Climate

The earth's atmosphere contains immense energy and momentum. Although it is debatable whether man's activities are changing climatic trends, no one project can be demonstrated to be significant. In this study, local changes are treated as changes in air quality and not as changes in climate. The reason is that climate has to do with energy flow as conveyed by air masses; it is described by factors such as humidity, temperature, and solar intensity. Unless a change can be shown to affect these factors, no change in climate can be demonstrated.

Climate, however, has an immense impact on effects of the project. Changes in air quality arise from interactions between climate and emissions. Dramatic climatic events can give rise to accidents. The respiration of flora and fauna is at the mercy of climatic factors. Therefore, climate enters implicitly and explicitly into the determination of many impacts of the project. Climatic effects are discussed in the context of other impacts.

3.1.1.1 Sea Leg

No measurable changes in climate have been ascribed to worldwide shipping operations and none is expected from this project.

3.1.1.2 Long Beach Port and pipeline route

The local micrometeorology is somewhat changed by atmospheric pollution in the Los Angeles Air Shed. Ozone and some photochemical precursors absorb ultraviolet rays, and aerosols scatter and absorb visible rays. The net amount of change as a result of the project anywhere would be undetectable.

3.1.2 Major ecosystems

3.1.2.1 Marine (Port)

3.1.2.1.1 Construction

Dredging would remove some polluted bottom material, causing entrainment of benthic fauna and larval fish. Removal of the benthos reduces the fishes' food supply. Both fish and some birds would be temporarily displaced by the dredging. Turbidity is expected, as is some release of nutrients, trace metals, and chlorinated hydrocarbons from the sediments.

Released nutrients may cause phytoplankton blooms and increase biochemical oxygen demand (BOD). This could cause mortalities among some organisms. Turbidity, especially adjacent to the hopper dredge, would persist throughout the water column. A high concentration of suspended solids can clog the gills of filter feeders and fish, causing some mortality. Zooplankton eggs and larvae also would be adversely affected. Reduced light penetration associated with turbidity may cause some decrease in phytoplankton productivity as well as disrupt larval fish development. Additional mortality to fish may result from displacement stress and reduced sight-feeding efficiency. Redeposition of suspended materials would cause burial and smothering of benthic and sessile organisms and habitat disruption.

About 79 acres of soft-bottom habitat would be destroyed through dredging. However, benthic repopulation is expected to be rapid. The fish nursery function of the harbor would be negligibly affected by deeper channels; these would benefit the dominant harbor fish species. About 22 acres of soft-bottom habitat would be permanently eliminated by the placement of the breakwater and trestle. The existing rocky shore community on the seaward face of Pier J would be changed. However, new hard substrate habitat would be created for algae, invertebrates, fish, and birds.

Year 2000. The cumulative impacts on circulation, water quality, and marine life resulting from the SOHIO project alone would be slight. When considered along with the trend for further development of the Port, such as the Port of Long Beach general plan, these impacts become more significant. A decrease in water-surface area will destroy part of the harbor's living medium for both producers and consumers. The landfills will also cover soft-bottom habitat, reducing fish food supply. Elimination of benthic habitat will significantly reduce populations of bottom fish and anchovy. The armor rocks will attract different species of fish. The fills will create new terrestrial habitat with limited benefits for vegetation, birds, and rodents. The new terrestrial habitat will eliminate feeding and resting habitat for birds. The combination of less living space and food, restricted circulation, and poor water quality will significantly reduce populations in the harbor.

3.1.2.1.2 Operation

Impacts on marine organisms and ecosystems would primarily result from accidental crude oil spills, both major and minor (note Section 3.1.5.1.2 on spill characteristics). Such spills could be produced by groundings, collisions, ballasting, bilge discharge, etc. Chronic low-level fuel leaks and bilge waste from pilot boats and tugboats associated with the tankers in port also would produce impacts.

Oil can deleteriously affect marine organisms in basic ways (MIT's Offshore Oil Task Group, 1972) by disruption at or below the cellular level, a cellular effect; disruption above the cellular level (biochemical processes), a physiological effect; disruption of instinctive and/or voluntary control, a behavioral effect; and disruption of habitat. These effects can be described by one or more of the following responses or changes: (1) lethal toxicity; (2) sublethal disruption of physiological or behavioral activities; (3) smothering, heat loss, and loss of mobility; (4) organismic incorporation of hydrocarbons leading to accumulation of hydrocarbons in food chains and/or tainting; and (5) changes in biological habitat.

It should be stressed that the responses or changes, other than the immediate lethal toxicity, all can result ultimately in the death of the organism or elimination of a species. The sublethal disruption of physiological and behavioral processes is often the result of chronic low-level oil pollution. These effects are discussed in more detail under vegetation (Section 3.1.7) and wildlife (Section 3.1.8). However, some examples are: increased susceptibility to disease, reduced growth rate, reduced fecundity, and loss of sensory sensitivity leading to inappropriate, maladaptive behavior. Coating of the organism with oil can result in death through smothering, heat loss, and loss of mobility. Incorporation of hydrocarbons leading to their accumulation in food chains can result in toxic levels in higher members of the chain far removed from the original pollution source. Changes in biological habitat occur when, for example, oil coats the substrate making it unsuitable for settlement of planktonic larvae.

Toxicity of oil is closely related to solubility in water, which decreases with molecular weight. Soluble aromatic hydrocarbons and their derivatives are the most toxic components of crude oil. Among the soluble aromatics, naphthalenes appear to be highest in toxicity (Anderson et al., in press). Because of the toxicity and high solubility of low-to-medium molecular weight fractions, these chemicals are potentially the most deleterious components of crude oil in terms of ecological impact. Low molecular weight paraffinic hydrocarbons are less soluble, but may induce narcosis leading to death. Crude oil exposed to environmental weathering forces rapidly loses the low-molecular-weight components through evaporation and dissolution. Consequently, weathered crude is somewhat less severe in its significance to the ecosystem relative to fresh crude and refined petrochemicals of the lower boiling ranges. Equivalent volumes of refined petrochemicals (diesel and fuel oils) are much more toxic than crude oils. Residual oils are depleted in lighter fractions and are low in toxicity, but can have important mechanical effects on organisms and their environment. Microbial oxidation operates to reduce straight-chain paraffinic components of spilled oil after a period of time, but dissolution of the higher molecular weight aromatics is very slow. Some of the latter may have carcinogenic properties. (Note: The composition of Prudhoe Bay crude oil is given in Table 3.1.5.1.2-10.)

The environmental impact of spilled oil depends upon many variables, as follows:

Some Variables of Oil Spills and Their Effects on Marine Communities and Organisms

1. Characteristics of the oil:
    - Original composition, including aromatics and diaromatics, carcinogens, etc.
    - Age
    - Solubility
    - Total amount
    - Concentration
2. Fate of the spilled oil:
    - Dilution
    - Evaporation
    - Photo-oxidation
    - Adsorption on particles and sedimentation
    - Microbial degradation
    - Solubility
    - Treatment of the spill
3. Physical and chemical environmental characteristics:
    - Amount of freshwater (salinity)

Suspended sediment (organic and inorganic)

Temperature

Tide

Wave force, period, and direction

Wind velocity and direction

Geographic location and climate

Time of year (season)

Photo-intensity and photoperiod

Substrate: particle size (chemical, composition, stability)

Water quality

Shape and size of cove, estuary, harbor or shoreline

Type of beach: rock, sand, slope

Natural or artificial barriers (complete or partial) to oil flow or wave currents; e.g., flotsam, kelp beds, bulkheads, etc.

4. Biological characteristics of the organisms:

Species

Age

Sex

Molting stage

Condition and general health

Time of year; reflecting spawning season, migration

Previous acclimation

Size

Metabolic rate

Proximity to range periphery

Bacterial inoculum

References for the partial list of variables, shown on the above tabulation, come from various literature sources (Evans and Rice, 1974; Anderson et al., 1973; Foster et al., 1971; Straughan, 1971; Swift et al., 1970; Battelle Northwest, 1973) or common knowledge.

Refer to Sections 3.1.5, 3.1.7, and 3.1.8 for detailed discussions of the impacts on water quality, vegetation, and wildlife.

Impacts other than those resulting from crude oil spills also would occur. They would probably be much less severe, although still significant. Included are increased levels of hydrocarbons introduced into the water from atmospheric pollution; increased vessel traffic and noise (both of particular importance to marine mammals); increased sewage discharge; and more people. The latter applies to Port Valdez where the population is expected to double. This increase would impact the marine ecosystem through greater hunting, fishing, collecting, trampling (in intertidal areas), and so on.

As stated in Section 2.1.2, this analysis emphasizes the northern Gulf of Alaska and central and southern California. Because the vessels would be more than 150 miles offshore in the intervening sections of coast (British Columbia, Washington, and Oregon), it is believed that these areas would not be significantly impacted by the project. An exception to this, however, could occur if a tanker had mechanical problems and had to put in or be towed into an intervening port. Portland could accommodate empty 165,000 DWT tankers in dry dock. The 80,000 DWT tankers could be handled in any of the major West Coast ports with repair facilities. The frequency with which these vessels would have to put into intervening ports is such that they would not significantly contribute to chronic pollution. However, the possibility of a large scale spill occurring as a result of such an emergency visit should not be ignored. Chapter 4 lists mitigating measures to help cope with this possibility.

One of the most serious aspects of oil pollution is that oil can become trapped in bottom sediments, especially mud or tidal flats, and be periodically released for years. Naturally, oil impacting a high-energy environment, such as an open, surf-swept beach, would not remain as long as it would in a low-energy environment, such as a bay. The following Table 3.1.2.1.2-1 shows the minimum persistence time in years for weathered oil.

Table 3.1.2.1.2-1

Minimum Persistence Time of Weathered Oil[a]

LOCATION	Time Span	Comments
Offshore	4 years	Author's estimate after two years; analytical methods; used #2 fuel (Blumer and Sass, 1972)
Rocky shore	3 years	Interpretation from statement made by authors; analytical techniques: crude oil (Straughan, 1973)
	2 years, 2 months	Analytical determination of oil (Scarratt and Zitko, 1972)
	9 months	Visual observation -- emulsifiers used on crude (Smith, 1968)
	4 months	The authors cite visual evidence of oil retained in rocky ledge by false eelgrass for several months (Clark and Finley, 1973)
Worm and clam flat	10 years	Visual observation and analytical; JP-5 and #2 fuel (Shenton, 1973)
	2 years, 2 months	Analytical determination of oil (Scarratt and Zitko, 1972)
Sandy shore	3 years	Gas-liquid chromatography analysis (Spooner, 1971) and interpretation from statement made by authors; analytical techniques; crude oil (Straughan, 1973)
	2 years, 2 months	Analytical determination of oil (Scarratt and Zitko, 1972)
	9 months	Visual observations -- emulsifiers used on crude (Smith, 1968)
Salt marsh	4 years	Teal, 1973

Source: Council on Environmental Quality, 1974.

[a] The maximum times listed do not necessarily imply complete removal of oil, but may represent authors' estimate of persistence, or the termination of study. Shorter times are simply times when authors found oil, not different persistence-time estimates.

Year 2000. An increase in ship traffic increases the hazard of accidental spills and collision. Chronic spills of oil and other pollutants could reduce species diversity of marine communities. The cumulative impacts would depend on the frequency and amount of incremental and catastrophic oil spills. The SOHIO proposal should be considered as part of a trend toward further development of the port and the subsequent increases in ship traffic.

3.1.2.2 Terrestrial biomes

3.1.2.2.1 Conversion/construction

As previously discussed, natural vegetation, wildlife, and ecosystem relationships already have been drastically altered by man's activities along the western California segment of the pipeline route. The construction and maintenance of the proposed pipeline project would add to the disruption of natural ecosystems where they exist and to varying degrees affect ecosystems already adapted to man's influences, but because the pipeline involves only a narrow strip of disturbance through the major ecosystems, the adverse effects to total major ecosystems would be relatively insignificant.

In structurally complex climax communities of the California Coastal Biome, impacts resulting from approximately 84 miles of construction may be small because these communities have evolved the ability of adapting to stress. For example, exotic grasses have almost completely replaced the native California steppe with no apparent major ecological consequences. Construction impacts may assume greater importance in stable climax plant and animal communities which are of limited size, or surrounded by impacted environs, such as freshwater marshes of the San Gabriel River. Construction in such communities could further reduce their size and/or environmental integrity.

In simple biological communities with low stability, such as in the Sonoran Desert, susceptibility to alteration by construction is high. Construction may further simplify these communities causing reduced stability. Reduced stability may increase the time required for recovery, or destroy recovery capability. However, new pipeline construction in fragile desert ecosystems would be of a limited extent (approximately 31 miles in the Colorado Desert Biome and 40 miles in the Yuman Desert Biome). Also, much of the new construction in the desert utilizes existing rights-of-way, ORV open areas, and agricultural lands presently being impacted by man. Construction of the proposed pipeline within these areas should not create major additional impacts because most vegetation and consequently wildlife has already been altered. For example, in the Colorado Desert, approximately 12 miles of the 31 miles of new construction passes through an area designated by the BLM as open to off-road vehicles (ORVs), and about 5 miles goes through private agricultural land. In the Yuman Desert, approximately 34 miles of the 40 miles of new construction follow an existing pipeline right-of-way including all 15 miles within the Kofa Game Range.

When topsoils are excavated for rights-of-way and the pipeline trench, soil microorganisms and the producer green plants would be destroyed. With the elimination of the basic food-web elements, the present ecosystems would cease to function along the disturbed right-of-way. Even where soils are replaced and revegetation is successful, the reconstituted site would differ from that existing before disturbance.

Disturbances of the limited natural ecosystems along the pipeline would create the most serious impacts, especially for the wildlife (consumer members) of the ecosystems. The riparian woodland habitat type in San Timoteo Canyon as described in Table 2.1.7.2-1, and the short-grass prairie habitat type from Jal, New Mexico to Midland, Texas contain scattered areas of relatively undisturbed native vegetation. Adverse impacts would occur primarily during the construction phase of the project. Biotic communities would be adversely affected not only by the loss of habitat but also by the disturbance created by human presence and mechanical equipment. In some areas adverse impacts would be long lasting. For example, pump stations would effectively remove wildlife habitat for the duration of the project. Other ancillary facilities, such as construction camps and temporary access roads, would result in minor impacts since the productivity would gradually recover.

3.1.2.2.2 Operation

Although the possibility is remote (see Table 3.1.5.2.2-1), an accidental oil spill could have a slight to major impact on the ecosystems encountered along the pipeline route. Oil spills would follow the natural drainages and bottomlands where the greatest biomass within an ecosystem is generally found. Therefore, a terrestrial oil spill could potentially adversely affect a significant amount of an important component of an ecosystem, especially in the south-western deserts. Vegetation in these deserts is usually quite sparse except along the bottoms of gullies and draws where infrequent rainwater tends to accumulate.

3.1.2.3 Aquatic

3.1.2.3.1 Conversion/construction

The basic productivity of aquatic ecosystems would be lowered for a short period during and after construction in a segment of those creeks and rivers crossed by the route. Increases in turbidity would cause an alteration in consumer populations at higher trophic levels when the microscopic and macroscopic biota are altered. The reproduction of game, commercial, and forage fish and the reproduction and growing conditions for commercial and rare mussels and other macroinvertebrates would be adversely affected for probably one breeding and growing season.

3.1.2.3.2 Operation

The influence of operation and maintenance on the aquatic ecological interrelationships is expected to be minimal. The greatest potential impact to the aquatic ecosystems that could potentially be encountered would be caused by an accidental oil spill.

An oil spill is a unique ecological problem, dependent upon the amount and character of spillage, organisms involved, amount of suspended material in the system, and physical variables such as wind, current, and water temperature (Mitchell et al., 1970).

Oil introduced into the aquatic environment would initially be toxic to many primary producers. Further damage would result from oils entering plant tissue where it would affect cell membrane permeability and interfere with cellular respiration and photosynthesis. Oil would have similar effects on consumers by interfering with gas exchange, restricting filter-feeding, and changing existing benthic habitats. Ultimately, changes occurring at lower trophic levels would result in modification or reduction of members near the top of the food chain (e.g., fish, predators, and waterfowl). Modification or reduction of aquatic macrophyte communities would ultimately reduce the available habitats for waterfowl and other animals that rely on shoreline macrophyte communities for feeding and reproduction.

The impact of an oil spill from the proposed pipeline could be slight or catastrophic to the aquatic ecosystem, depending on the volume of the spill. At the least, one could expect elimination of many or most of the periphytic and benthic microscopic plants in the downstream vicinity of the spill. Oil remaining on the shoreline and on bottom sediments also would prevent or retard recolonization (Cairns et al., 1972). This could result in a downstream area that would require time for benthic aquatic plant life to become reestablished.

The overall effect of oil deposits in sediment layers involves interferences with gas and nutrient exchange between the sediment-water interface. Most sediments in which oil is incorporated become low in oxygen content or anaerobic, restricting or retarding recolonization by many microscopic plants.

3.1.3 Geologic setting

3.1.3.1 Topography

The original shoreline, marshes, and other natural features no longer exist in San Pedro Bay; therefore, construction of the proposed facility would have no impact on the natural topography of the marine and Port areas. Some change, however, would occur in the harbor floor through deepening of the existing channels and creation of a new channel at the terminal site. Changes would also occur to the topography because of the construction of the pipeline. Trench excavation and backfill would leave scars until the existing regimen was reestablished. The location and extent of resulting impacts are delineated in Attachment 1, Maps 2.1.3-1 through 2.1.3-12.

3.1.3.1.1 Marine and Port

No impact is expected on topography other than at the Pier J area and the landfill areas.

3.1.3.1.2 Pipeline route and terminals

The principal impact to the topography resulting from construction of the pipeline would be changes in the forms of the terrain along the pipeline route. These changes would be relatively minor and would only involve regions where new construction or extensive modifications of the existing pipeline were anticipated. Minor but permanent changes in the landforms in these areas would result from trench excavation, access-road construction, and grading. The main impacts identified as being related to these construction activities are visual changes in landforms and alterations to existing drainage features.

Significant short-term changes to the topography would occur where construction activities involve trenching across river channels. Existing plans call for relatively deep underwater excavations (below calculated scour depth) at these crossings which would remain open until the pipeline is laid, conceivably from several days to a few weeks. The resulting temporary changes in the channel configuration could cause increases in stream bank erosion and river-bottom scour, and could result in greater sediment loads in the downstream areas. Once the pipeline has been installed, these trenches would be backfilled and the stream channels would be returned to their original configuration. Current plans require trenched crossings at the San Gabriel, the Santa Ana, the Colorado, and the Pecos rivers.

3.1.3.2 Geology

3.1.3.2.1 Marine and Port

The project would have no significant effect on the local geology within the harbor and Port areas. The excavated material from the channels would consist mostly of sandy silt, which is less desirable for hydraulic fills and is undesirable for beach replenishment. Excavation might possibly expose the organic strata encountered in two borings drilled by Converse Davis Dixon Associates. At this time, it is believed that these strata are not of sufficient extent that their exposure would adversely affect the marine environment.

3.1.3.2.2 Pipeline route and terminals

The most significant impact on mineral resources resulting from operation and maintenance of the pipeline would be a major oil spill resulting from a pipeline break. Open sand and gravel pits and quarries located close to and downslope from the right-of-way would be subject to an inflow of released oil that would necessitate expensive cleaning operations or even abandonment. Impacts to these mining activities depend upon the quantity of resources preempted, the proportion of the obligated area compared to the owners' total, and how many other similar mining operations are producing in the vicinity. Commercial and private pits and quarries susceptible to contamination from an oil spill are located in the following areas:

1. In the Santa Ana River floodplain, California.
2. West of Lordsburg, New Mexico.
3. Around Deming, New Mexico.
4. On the west slope of Anthony's Gap, Texas.
5. In the suburban areas of Midland, Texas.

It should be noted that while this list is complete by current information, additional pits and quarries may be opened at new locales during the life of the pipeline.

Although the proposed alignment avoids rock formations, bedrock excavation using explosives may be necessary across the Jurupa Mountains, California, the New Water Mountains, Arizona, and the Guadalupe Mountains, Texas, and the Pecos River crossing in New Mexico. Adverse effects from blasting could result from vibratory ground motion, loud blast reports, and flying rock. Impacts could be destroyed property, cracked plaster and windows of residences, frightened livestock and wildlife. Compaction of loose soil could affect subsequent agricultural production or even reduce the flow of springs by compaction of soil over near-surface groundwater aquifers.

3.1.3.3 Geologic hazards

3.1.3.3.1 Marine and Port

Ground subsidence and tsunamis may affect the terminal facilities during its lifetime. Should significant subsidence from hydrocarbon withdrawl recur in the Long Beach area, the pipeline could be ruptured as many pipelines were ruptured between 1928 and 1965 before this subsidence was controlled (Alfors et al., 1973). Tsunami hazard is considered unlikely, but still worthy of note. The superposition of a 4-foot-high tsunami on a high tide could damage the terminal facilities and tankers in the Port.

Transoceanic tsunamis would not affect shipping that is not in nearshore areas. Of more concern is the possibility that uplifting of the sea floor would occur as part of the seismic activity. Water depths are very deep throughout the route. Uplifting should not affect safe passage although shoaling might occur near terminals at either end. The likelihood of this occurrence cannot be determined within the present state of knowledge. It can be expected though, that if such a severe seismic event should occur, surveys would be undertaken, as they were following the Alaskan earthquake of 1964, to determine the changes in bathymetry in shallower areas.

3.1.3.3.2 Pipeline route and terminal

Slope instability

Slope instability could cause damage and rupture to the pipeline and associated facilities from landslides, debris flows, and rock falls initiated by ground vibrations (earthquake, blasting) or construction excavation.

Landslides that could pose a threat to the integrity of the pipeline have only been identified in the Puente Hills of southern California and will receive additional geologic investigations by the applicant. Construction activities for the pipeline alignment through the Puente Hills could induce landslides, for instance, if excavations were made into existing landslides or landslide-prone materials, or otherwise disrupting the natural equilibrium were otherwise disrupted. Effects of landslides on the pipeline would depend on the location of the pipe with respect to the slide and could include bending, removal of support, or rupture. Rupture of the pipe would result in oil spills and would directly affect vegetation and water quality. Damage to the system would require maintenance or repair operations.

Rockfalls could occur in the Dome Rock Mountains and Peloncillo Mountains, Arizona, and the Guadalupe Mountains, Texas, where construction and maintenance activities associated with the pipeline might disrupt rock outcrops loosened by blasting vibrations or other construction or maintenance activities. Earthquakes are also a possible cause for ground vibrations in the Dome Rock Mountains area.

Erosion and scour from flooding

The applicant plans to bury the new segments of concrete-encased pipeline below calculated scour depth at major river crossings. Foundation supports for proposed overhead crossings would be designed to accommodate scour effects. Consequently, no impact from scour is expected at major river crossings. However, scour can be a problem in desert washes, where flash flooding can damage the pipe by eroding stream channels and banks, removing supports or transporting debris that can lift out or rupture an exposed pipe. While no instances are known where existing pipelines have been ruptured because of scour or impact, there are cases where a 1-mile length of 26-inch and 30-inch natural gas pipeline has been floated out of its trench during a flood at Centennial Wash, Arizona (Soil Conservation Service, 1976). It must be pointed out that the weight of the above-mentioned natural gas pipeline was significantly less than a crude oil-filled pipeline of the same size.

Debris flows can be expected in the desert environment, during the life of the project, between Beaumont, California, and the Pecos River, New Mexico. They are caused by summer thunderstorms or other intense precipitation periods, and are unpredictable in intensity, location, and time of occurrence. Effects from debris flows would be restricted to drainage channels, and would result in scour of pipe bedding or pipe supports, bending, and possible rupture of the pipe, burial of exposed pipe segments, or puncture by impact of large debris.

Subsidence and differential settlement

Subsidence resulting from groundwater withdrawal is a common occurrence in deep groundwater basins throughout the Southwest. As groundwater is pumped, a subsidence bowl develops around the well field creating tensile stresses around the periphery of the subsidence bowl, resulting in vertical offsets of 1 to 3 feet and associated ground fissures. Initially, these cracks may be no more than .5-inch wide, but they enlarge rapidly to fissures several feet wide and attain a depth of 100 feet or more.

Although fissures and ground surface offsets of this type might expose short sections of the pipeline, the strength of the steel pipe should be sufficient to prevent rupture until the problem could be corrected during routine maintenance. For example, a 12-inch gas pipe which crossed a 0.7-foot-deep offset fissure near Picacho Peak, Arizona was excavated for inspection. No signs of damage or stress was found on the pipe; however, a 30-inch pipe filled with heavier crude oil might not fare as well. Rigid foundations of pump stations, valves, and other appurtenant facilities may be seriously affected by cracking or tilting if they are sited in areas experiencing ground settlement or fissuring.

Areas on the pipeline alignment where subsidence due to fluid withdrawal is known to be occurring include the alluvial basin south of Chino, California, the Picacho area between Casa Grande and Coolidge Pump Stations, the Sulphur

Springs Valley near Willcox, and near Bowie just west of the Cochise Pump Station in Arizona (Wentworth et al., 1970; Robinson and Peterson, 1962).

Faulting and seismic hazards

The remainder of this section discusses various hazards associated with the natural occurrence of earthquakes which could affect the integrity of the pipeline and associated facilities. Earthquakes can also affect the operation of support equipment, including emergency equipment which is intended to control or mitigate problems associated with failures in the system. For example, special power or communication facilities, which are intended to close valves, control fires or otherwise assist in preventing or containing damage that may result from seismic-caused failures of the pipeline, can in themselves be rendered inoperative as a result of the same earthquake that causes failure of the pipeline, depending upon the earthquake magnitude, its distance, duration of strong shaking, and local geological conditions.

Earthquakes causing system failures and spills, which in turn cause fires, are the most serious potential impacts associated with oil storage and transmission facilities located in seismically active areas. These impacts can be triggered by a number of different earthquake effects. Seismic ground shaking and flooding by seismic sea waves have both been identified as causes of pipeline system failures and fires involving oil facilities. Although the state-of-the-art of earthquake engineering falls short of perfection, and it is not therefore possible to "guarantee" that failure would not occur, facilities can be sited and designed and adequate safety systems provided so as to reduce the probability of catastrophic failures to a very low level.

Review of preliminary information submitted by the applicant indicates that appropriately detailed investigations of earthquake hazards are underway. However, in the absence of complete investigations or actual designs, the following comments on potential hazards can be regarded as only preliminary. Some form of seismic activity probably will affect some portion of the project in California, but probably will not affect the project east of California.

Surface fault displacements. Pipe rupture as a result of faulting is an occurrence with much higher probability in California than in areas crossed by the pipeline to the east. The greatest risk of rupture exists at the intersections of the pipe with known active faults that could experience displacement during earthquakes. Faults that have the highest potential for displacement, as discussed in Chapter 2, are the San Jacinto fault zone and the San Andreas fault zone. Because of the uncertainty regarding the exact place of rupture to be expected in the fault zones, the applicant has estimated a maximum oil spill to be about 9,200 barrels if valves operate as expected. The oil spill volume could be greater if the earthquake damages the valve systems and they fail to close.

Effects of oil spilled from the pipe as a result of accidental rupture at the San Jacinto or San Andreas fault zones could impact soil and water resources to various degrees, depending upon how long it took to close the valves on either side of the rupture, the amount of oil spilled, physical characteristics of the area (topography, vegetation, soils, etc.) and the efficiency of the clean-up operations. Specific impacts are discussed in detail in the appropriate sections (soil, water, etc).

Earthquake shaking. Detailed studies have been prepared for the applicant (Holmes and Narver, 1976) setting forth proposed basis for design of the California and east of California segments of the pipeline and associated facilities to protect from the effects of seismic shaking. These reports generally reflect the current state-of-the-art in earthquake engineering, and propose that methods be used in design of the pipe which are much more detailed and generally more conservative than those recommended in standard codes or used in traditional oil pipeline design practice.

Because most of the pipeline outside of California already exists, design parameters presumably would be used to check the adequacy of the existing pipeline or to design new facilities which would be necessary for conversion of the existing pipeline to oil transportation.

Shaking-induced failures of either permanent or temporary (emergency) power or communications systems constitute an important potential secondary failure of the system, because such failures can render emergency facilities ineffective. Earthquake-induced fires are another important secondary effect.

Secondary ground failures. In addition to the hazard of ground rupture at faults, earthquakes may generate other types of ground failure which may affect pipelines and related facilities. These other types of ground failure include landslides and rockfalls, lurching, flow slides, settlement, and loss of bearing capacity, all of which may be caused directly by ground vibrations or liquefaction caused by ground shaking. These secondary ground failures are commonly more widespread and potentially more damaging than fault ground rupture.

Ground failures, particularly slide movements, related to seismic soil liquefaction constitute a significant and relatively widespread hazard to the pipeline in California. Areas that have been identified as susceptible to liquefaction hazards include the Long Beach Port facilities area, that portion of the pipeline which flanks the Los Angeles River, the Santa Ana River area, and the area in the vicinity of the Colorado River. From the standpoint of possible adverse impact, the potential for liquefaction-induced ground failure and consequent failure of the pipeline or storage facilities in the urban Long Beach Port and Los Angeles Basin areas constitutes one of the most serious potential hazards to the pipeline. Present plans call for in-place densification of the fill at Pier J using the Menard "Dynamic Consolidation" process which will cause the soil to be resistant to liquefaction.

Outside of California, the relatively lower seismic activity reduces the potential of liquefaction to a much lower level than reported in California. Even though there have been no historic cases of liquefaction along the proposed route, the pipeline does traverse a belt of seismic activity in western Arizona at the Colorado River crossing and western New Mexico at the Rio Grande, which is sufficiently active that some potential for liquefaction ground failure can be reasonably assumed where other favorable conditions -- loose cohesionless soils and high groundwater table -- are present also.

3.1.4 Soils

3.1.4.1 Marine

3.1.4.1.1 Construction/operation

Benthic zone

The associated dredging would remove some polluted bottom materials from the proposed dredging areas. This constitutes a beneficial impact. There are no anticipated impacts on sediments in other areas within Long Beach Harbor.

Deposition areas

Any dredge material which was not used in the breakwater construction would be deposited at the EPA-approved ocean disposal site. No material which exceeded EPA pollution criteria would be used for breakwater construction. The EPA is responsible for assessing the impacts on its approved disposal sites prior to final designation. The Los Angeles #2 site is currently an interim disposal area which has been previously utilized for many dredge material sources. Thus the bottom sediments at the disposal site have been disturbed from their original or natural condition. The SOHIO project would contribute to a continuing disturbance of sediments at the site. The dredged material meets EPA criteria for unpolluted material except as noted in Section 2.1.4.1. Possible impacts on biota in the vicinity of the Los Angeles #2 site are presented in Section 3.1.8.1.1, under Port of Long Beach area.

Year 2000

Reducing the tidal prism reduces the tidal movements; consequently, critical velocities governing erosion and sediment deposition can be altered. If the energy patterns are altered, present areas of erosion could possibly become areas of deposition, and present areas of deposition could possibly become areas of erosion.

3.1.4.2 Pipeline route

3.1.4.2.1 Conversion/construction

Because of the limited linear and areal extent of construction at any one location, and because of the rapid rate at which construction would proceed (0.5 to 1.0 mile per day for pipeline installation), precise adverse impacts on the soils would be virtually immeasurable at most locations. This assumes that construction would occur during a normal climatic year when average annual rainfall was in the range of 4 to 12 inches and runoff ranged from 0.2 to 0.5 inch per acre annually (USGS, National Atlas, 1970). Micro-changes, as in mixing of desert soil profiles, would be reflected by measurable changes in the biotic components of the system rather than in the soil itself.

Impacts on soils would include:

1. Loss of protective vegetation.
2. Loss of soil and on-site productivity from water action.
3. Soil compaction followed by a loss of productivity.
4. Loss of soil and on-site productivity from wind action.

5. Potential erosion and soil loss from test water discharge.
6. Loss of soil fertility by intermixing.
7. Soil contamination by fluid leaks or spills.

Pier J to Beaumont

Soil protecting native and introduced vegetative species would be removed from approximately 1,006 acres. This total may vary depending upon the precise location of the pipeline in relation to vegetated or nonvegetated sites (e.g., railroad right-of-way). Included in this total is approximately 556 acres of cropland that would be disrupted.

During normal years, soil loss from water erosion is negligible, since infiltration and percolation retard surface flow on the highly permeable loamy and coarse sands and coarse sands which constitute approximately 60 percent of the route. Cropland soil loss also would be immeasurable because the gradient less than 3 percent keeps runoff water from reaching erosive velocities. Compaction of croplands caused by equipment would be a short-term impact.

Overland flow, if other than in channels, normally would not develop erosive velocity when crossing the 50 to 100 feet of clearing from the adjacent hillsides. Exceptions might occur in areas like the Puente Hills where gradient would exceed 15 percent. However, sustained slopes of a few hundred feet in a straight line would provide a course along which runoff might accelerate to velocities causing rills and gullies and deposit sediment on urban and rural facilities and lands below. Excavation of shallow soils in shale areas on such slopes would require excavation which would result in loss of productivity of 20 to 40 inches of soil.

With the exception of the coarse-textured sandy and gravelly streambed soils, such as those encountered at the San Gabriel and Santa Ana river crossings, excessive soil compaction can be expected on undeveloped lands.

Compaction is caused by track- and rubber-tread vehicles used in excavation and backfilling; trucking materials and supplies; and ancillary equipment. A detailed listing of these pieces of equipment is presented in Table 3A.2-7 (Williams Brothers, 1976) Environmental Assessment. Studies conducted on open lands indicate that the bulk density of loam, silt loam, and clay loam soils can be increased as much as 20 percent by vehicle use under similar nearly dry soil conditions. Under normal conditions, this degree of compaction can persist for several years, resulting in the inability of native plant seeds to germinate and revegetate the compacted trail. The severity of compaction varies with the frequency of duration of traffic, the soil moisture content, and the proportions of sand silt and clay in the soil surface horizon. Because of these variables, the first two of which are subject to drastic change during construction, predictive impacts cannot be absolute.

Loss of fertility by soil profile mixing resulting from excavation and backfilling would be apparent on the 556 acres of agricultural soils, and to some extent on 73 acres of rangelands, unless surface soils are stockpiled separately. This would be evidenced by decreased vigor of cultivated crops for a year or two and by decreased density and vigor of native vegetation for five years or more.

During construction, soil contamination would result only from inadvertent or accidental oil or gasoline losses from motorized equipment or storage containers. It is expected that, with normal precautions, these occurrences would be very localized and minor in all segments of construction.

Ford Dry Lake to Colorado River

The second segment of construction is in the Colorado River Basin and extends approximately 31 miles. Of this distance, 25 miles would be on previously undisturbed vacant land and 6.2 miles on cropland. These distances convert to an estimated 303 and 75.2 acres of disturbance, respectively. Alfalfa and vegetables are the principal crops involved.

Soils traversed in the relatively undisturbed portion of this segment from Ford Dry Lake to the Palo Verde Valley cropland are chiefly gravelly and loamy fine sands of the Carrizo-Rositas association and soils of similar textures (Map 2.1.5-5, in Attachment 1) water erosion is low. Permeability ranges from rapid to very rapid and The low gradient of the pipeline route and gentle side slopes for most of the distance are not likely to encourage measurable movement of these soils under normal climatic conditions.

The sparse native vegetation provides some protection for the soil, particularly by preventing the frequent strong winds from developing soil-moving velocities at ground level. Should the pipeline route be aligned with prevailing winds, continued loss of productive silt and clay particles would accrue until the heavier gravels again formed a natural protective pavement, a process that takes one to two years.

Loss of these permeable soils by runoff, either along the pipeline or at right angles from side slopes, normally would be negligible. As in other portions of the desert, normal precipitation rates do not exceed 6 inches annually, and annual runoff is less than 0.2 inch (USGS, National Atlas, 1970). Massive and measurable soil movement takes place only during infrequent thunderstorms.

Soil compaction in this segment, except in loose, sandy drainages, would effectively reduce the bulk density to the point where native shrub revegetation cannot be expected to attain preconstruction conditions for 20 years or more.

Loss of soil by wind action during and after grading, excavating, and backfilling would be approximately 12.2 tons on these 303 acres. This assumes a loss of 200 pounds of soil per mile from grading, .04 pound per ton of soil from excavating, and .05 pound per ton of soil during backfilling (Williams Brothers, 1976). This loss is equal to approximately 80 pounds per acre and presents no measurable impact on productivity.

Construction of the Indio and Desert Center pump stations would remove soils on the sites from production of native desert plants for the life of the project.

New pipeline traversing 6.2 miles of the irrigated croplands area of Palo Verde Valley would be buried under existing county and farm access roads where feasible. The intent is to disrupt irrigation systems and perennial crops as little as possible. The presence of a high-water table in the floodplain (6 feet) presents problems in construction rather than impacts on the soil. Liquefaction of soil and maintenance of the sides of ditches during construction, as well as disposal of soil displaced by the pipeline, are foreseen as the major difficulties. Reduction in yields of certain crops directly over the pipeline could occur for one to two years.

Colorado River to Ehrenberg Pump Station

On the Arizona side of the Colorado River, the distance of new construction would be 5.5 miles or a total disturbance area of 66.7 acres. Land clearing for the pump station at Ehrenberg would result in a maximum of 10 additional acres of soil disturbance, compaction, and loss of productivity.

Since this section of proposed line is in the same climatic zone as the segment east of the Palo Verde Valley in California and is on similar land forms, soil loss from wind action would be largely immeasurable but would be in the vicinity of 3,700 pounds during construction. Compaction of soils by construction equipment would inhibit germination of native plant seeds, and would have a similar relative impact.

Livingston Pump Station to Gila Pump Station

Soil protective vegetation would be removed on approximately 400 acres as a result of expanding the right-of-way by 30 feet in the 34-mile segment of new construction between these stations.

Normally, loss of soil from water erosion is negligible in this continuation of the desert environment; average annual runoff is in the range of a nonerosive 0.1 to 0.2 inch per acre.

Soil compaction, which would inhibit seed germination and emergence of native vegetation for several years, would perhaps be the dominant impact.

Soil loss in the form of fugitive dust would be nominal in the rock-strewn mountainous region and in the coarse sandy drainage in and adjacent to Ranegras Wash. Elsewhere along the route in this segment, total loss of windblown soil is estimated at 12.2 tons or about 150 pounds per acre during construction.

Loss of soil fertility is not critical because of lack of soil development and inherent low fertility of these residual soils.

Guadalupe Pass

Installation of longer radius bends in the top and bottom of this 2.1-mile segment is proposed in order to permit passage of a dual-diameter scraper pig. Several hundred feet of right-of-way would be excavated for this installation. Impacts on soils in this segment would be similar to those described in the previous subsection.

Jal to Midland

Across 73.1 miles of this nearly level plain from Jal to Midland, approximately 886 acres would be impacted by the long-term loss of native vegetation and the effects of bare soil.

Average annual runoff is .2 inch, reflecting the desert-like environment. Because of low gradient and infrequent runoff, substantial impacts from surface water are not anticipated during construction. Soil compaction resulting from equipment use here, as elsewhere, is expected to have the most lasting impact on the soil surface by inhibiting seed germination.

Loss and/or displacement of surface soil as a result of grading, excavating and backfilling is estimated at 37.9 tons, or the equivalent of 84 pounds per acre along this 73.1 miles. This would have little or no effect on soil productivity.

Construction at Midland terminal on 40 acres of nearly level land would have temporary and minor impact on the soil because the site is within an existing storage tank complex. The present compacted surface inhibits growth of all vegetation except the hardiest of weedy species. In the event of sudden, large volume release, discharge of hydrostatic water would perhaps be the greatest impact on the soil at Midland. Although the terrain nearly level, the discharge of water would cause erosion and massive soil movement into existing drainage channels. If channels are not properly constructed and shaped, destructive headcutting and soil loss from subsequent runoff events would continue.

Transmission lines

Soil losses to the air from grading approximately 104 miles of access roads for transmission lines would be relatively lower than those losses from grading for the pipeline. Loss of productivity on this 151 acres would be permanent on frequently used access roads.

Hydrostatic test water

Details of the proposed hydrostatic testing are discussed in Section 1.2.3.2, Action following construction, and are outlined in Table 1.2.3.2-26. No provisions have been made for discharge at points intermediate to those outlined in the table, and the chances of accidental releases or the need for intentional releases at other than planned locations would be remote.

Effluent from the newly constructed line will consist chiefly of small quantities of mud and welding slag. Pollutants in the test water discharged from the existing gas pipeline would be significant. Dissolved or suspended iron and chemical oxygen demand (COD) would exceed water quality discharge requirements of all states. Chemical oxygen demand tests on similar lines averaged 409 mg/l, which is roughly equivalent to raw domestic sewage concentrations, and iron concentrations averaged 10 mg/l (Barkley, 1973).

If volume and velocity of release were not controlled, sudden release would generate a minimum velocity of 5 feet per second (fps), and a rate of roughly 50 cubic fps. This force is sufficient to move cobbles more than 10 inches in diameter as well as small rocks and soil (Johnston, 1945). The minimum area of scour on a gentle slope or in a sandy drainage would have a 9-foot cross section. The length of scour distance that soil would be moved would vary with the length and steepness of the slope.

3.1.4.2.2 Operation

Soil impacts that can be identified with oil pipeline operations are of two types. The first type is in the normal and predictable range of interrelated impacts associated with conventional operation and maintenance of the system. These impacts include permanent loss of protective vegetation, excessive soil compaction, and soil loss induced by wind and water. The second type is comprised of those that are possible or probable, but infrequent in occurrence and relatively catastrophic in nature.

In discussing the first of these two types, estimates of permanent impacts along the route and at ancillary sites can be made with a reasonable degree of accuracy.

Maintenance of an existing, permanent access road paralleling the pipeline, where needed and practical, is proposed from Ehrenberg to Jal. It is assumed that single-purpose access roads would not be maintained through croplands, in urban or industrial areas, or along existing rights-of-way used for other purposes. For this reason, soil surface impacts attributable to the pipeline operation from Pier J to the Puente Hills would be inconsequential. Similarly, the soil surface, from the emergence of the pipeline on the east side of the Puente Hills to the existing 30-inch pipeline west of Beaumont, would not be impacted solely by operation of this system.

The pipeline route through the Puente Hills would traverse previously undisturbed land for a distance of approximately 4.3 miles. Once the pipeline was installed, it is assumed that the cleared area would be used thereafter as access by the public if not as part of the operation. The effects of continued vehicle use would be permanent loss of protective vegetation and soil compaction on approximately 52 acres. Although preliminary routing through the hills indicates that some cleared slopes might exceed 15 percent for distances of a few hundred feet, permeability of the soil and newly excavated shale is sufficient that water from normal rainfall events would be absorbed. Excessive soil loss from wind or water erosion is not expected during normal years.

From the start of the existing pipeline at Beaumont and including new-segment construction, as described previously, access and maintenance roads along the route and into pump stations would be permanently compacted and devoid of vegetation. This area represents nearly 1.4 acres per mile. At each of the pump stations, a maximum of 10 acres would be similarly denuded and compacted.

Croplands and urban and industrial areas along the route would not need maintenance roads. Since annual average runoff for most of this distance is in the range of .2 to .5 inch and the pipeline gradient is low, soil loss on-site and sedimentation off-site during normal years would be virtually immeasurable.

The second type of impacts is less predictable. Causes and effects are either uncontrollable natural events such as flooding or landslide, or are human-related such as pipeline failure or inadequacy of oil leak detection systems. The most common of these include major pipeline rupture, storage tank failure, failure or inadequacy of leak detection systems, and incompatibility of soil with the conveyance system. These situations could result in massive soil contamination and contamination of surface water and groundwater in the vicinity of the occurrence.

Natural causes such as high intensity rainfall and runoff events can result in mass soil movement of stream banks or of ephemeral channels. These natural events, although infrequent, are typical of the arid Southwest environment. When sufficiently severe, soil supporting the pipeline might be removed to the extent that the pipeline would fail and bend or rupture. However, it is noteworthy that other segments of the existing gas pipeline which would be converted to carry oil have not experienced such a rupture in 20 years. With the additional weight of the oil in the line following conversion, rupture would be a viable consideration. Weight of the 30-inch line when carrying nearly 37 gallons of oil (.881 barrels) per foot of length would be increased by approximately 277 pounds per foot over that of the pipeline when it transported gas. Maximum length of span that can be safely tolerated under this weight is about 40 feet. This length is exceeded at the present time at several locations on the existing gas pipeline.

In the event of complete pipeline severance, the volume of oil spilled would be determined by the time required to detect the loss of pressure and to stop the nearest upstream pump, the gradient of the pipeline, and the distance of gravity flow. The initial rate of flow, until the pumps were stopped, would be 14,560 gallons (346.66 barrels) per minute. The balance of the spill would be gravity flow as determined by gradient and distance. In case of a rupture in a valley bottom, gravity flow would be from both directions (Williams Brothers, 1976). With the remote control shutdown system and a shutdown time of five minutes, a minimum of 72,800 gallons (1,733.33 barrels) or the equivalent of .2 acre-foot would be spilled. Additional spills by gravity would be contingent upon slope and location of valves. Probability of spills and maximum spills possible are discussed further in Section 3.1.5.2.2.

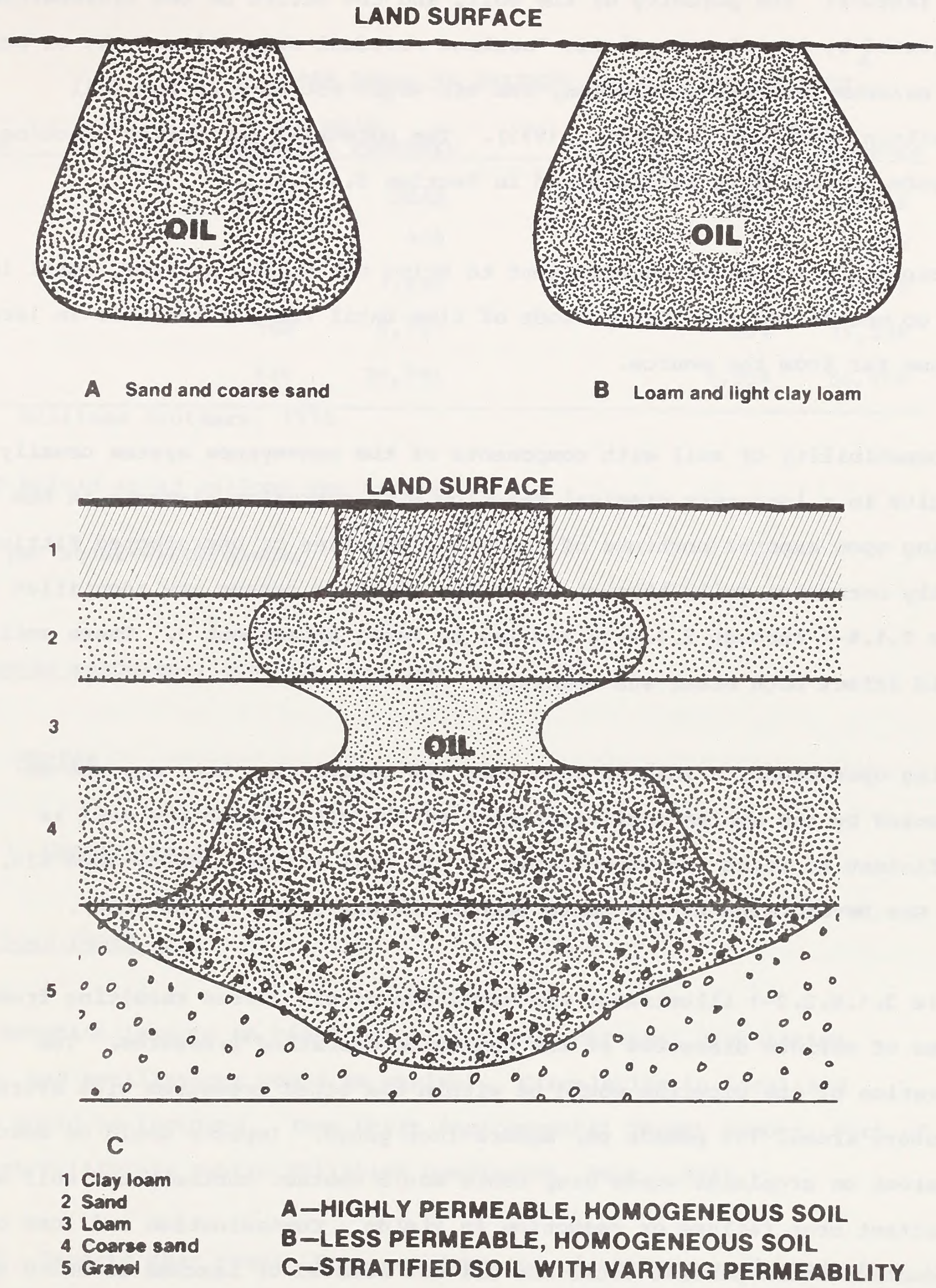
Many areas sensitive to soil and soil-related impacts can be identified along the route. Most sensitive of these would be the varying sized agricultural valleys of San Bernardino, Palo Verde, Gila, Casa Grande, Willcox, San Simon, Animas, Mimbres, and Rio Grande. The impact in these areas would be contamination of soil and consequent crop loss. If not removed or leached, oil present in the 2- or 3-foot surface layer of soil would remain for a few years until degraded by aerobic soil microbial action (Hubbard, no date). On noncultivated rural lands, the impact on soil and native vegetation resulting from pipeline rupture would be similar but longer lasting because of the slow leaching process under arid rainfall conditions and the absence of intense microbial action.

Other than flooding, natural events which can cause pipeline and tank rupture and massive spills are landslides, land subsidence, and earthquakes. Potential areas of hazard and impacts are identified in Maps 2.1.3-1 through 2.1.3-12, Attachment 1.

Failure or inadequacy of leak detection systems can result in massive soil contamination and vegetative loss under certain conditions. A slow leak over an extended period is most insidious, since often it is not detected until oil appears at some point where it is not wanted. By then the problem of cleanup may be very difficult and expensive.

Spilled oil commonly migrates along artificial fills, such as pipeline trenches, foundation fills, and utility conduits, in a manner somewhat related to its behavior in natural soils. Such excavations often are backfilled with material more permeable than that removed. These excavations consequently offer a migration route of minimum resistance, and any fluid would tend to move along them more rapidly than through natural soils.

Oil spilled on undisturbed ground would tend simply to move downward, under the force of gravity, while spreading laterally to some degree. The rate of movement depends on the viscosity of the oil and permeability of the soil. If the spill area is essentially round, the general shape of the area of passage is a cone, modified by the nature of the soil layers the oil passes through (Figure 3.1.4.2.2-1). The downward movement eventually would be interrupted by one of three events: the oil would be exhausted to immobility; it would encounter an impermeable bed; or it would reach the water table.


LAND SURFACE
OIL
OIL
A Sand and coarse sand
B Loam and light clay loam
LAND SURFACE
1
2
3
OIL
4
5
C
1 Clay loam
2 Sand
3 Loam
4 Coarse sand
5 Gravel
A—HIGHLY PERMEABLE, HOMOGENEOUS SOIL
B—LESS PERMEABLE, HOMOGENEOUS SOIL
C—STRATIFIED SOIL WITH VARYING PERMEABILITY

Source: Davis et al., 1972

Figure 3.1.4.2.2-1 Generalized shapes of spreading oil cones at immobile saturation

The volume of soil required to immobilize a given amount of oil depends on two factors: the porosity of the soil, and the nature of the hydrocarbon as reflected by its characteristic "maximum residual saturation." At or below its maximum residual saturation, the oil would not move in the soil (American Petroleum Institute, 1972). The potential for spills reaching groundwater aquifers is discussed in Section 3.1.5.2.2.

If capillary action is insufficient to bring oil to the surface, small leaks may go undetected for long periods of time until the oil surfaces in large volume far from the source.

Incompatibility of soil with components of the conveyance system usually results in a long-term chemical reaction with corrosive elements in the soil acting upon exposed portions of the steel pipeline or unprotected fittings. Highly corrosive soils through which the pipeline passes are identified in Maps 2.1.4-1 through 2.1.4-12 and Key to Maps, Attachment 1. These soils would affect both steel and concrete.

During operations, a leak of less than 100 barrels per hour may not be detected by the system until migration of the oil through the soil is sufficient to reach the water table or the soil surface (USDI, USGS EIS, Oil and Gas Development in the Santa Barbara Channel, Vol. 2, no date).

Table 3.1.4.2.2-1 illustrates the magnitude of oil losses resulting from holes of various diameters at the indicated operating pressures. The operation of the pipeline would be within the cited pressures with average pressure around 750 pounds per square-inch gauge. Impacts would be most apparent on croplands where crop roots would contact contaminated soil with resultant crop failure or reduction in yields. Contamination and loss of production would persist until the oil was removed or leached downward by several applications of irrigation water (Schwendinger, 1968).

Table 3.1.4.2.2-1

Loss Rates

	Leak Rates in Barrels and Gallons per Hour[a]			
HOLE DIAMETER	200 psig[b] Internal Pressure		900 psig Internal Pressure	
Inches	bbls	gals	bbls	gals
1/8	10	420	21	882
1/4	40	1,680	85	3,570
1/2	160	6,720	339	14,238
1	638	26,796	1,354	56,868

Source: Williams Brothers, 1976.

[a] 500,000 bbls/d at 42 gallons per barrel.

[b] Pounds per square-inch gauge.

3.1.5 Water resources, quality, and use

3.1.5.1 Marine

3.1.5.1.1 Construction

Port of Long Beach area

Any construction impacts on tidal heights, tidal currents, circulation patterns, and oscillations would be minimal. Circulation in localized stations would be improved. (See Draft Environmental Impact Report, Port of Long Beach/California Public Utilities Commission, Sept., 1976.)

Dredging. Impacts that result from construction of the proposed project would depend upon the physical and chemical character of the material to be dredged, the quality of the receiving waters, the type of dredge and disposal operation, and the potential for adverse impacts. A hopper dredge, see Figure 1.2.2.1-1, is the presently proposed dredging equipment for use in the Port of Long Beach area.

The location of the proposed dredging is shown on Figure 2.1.4.1-1. Sediment core samples were collected in the proposed project area (Figure 2.1.4.1-1), and the results are presented in Table 2.1.4.1-1. The type of sediment to be dredged exhibits small fractions of sand and generally greater fractions of clay (Spencer Classification). The most obvious effect on the offshore environment would be caused directly by the removal of substrate and indirectly by redeposition of suspended sediment and turbidity.

In general, the effect on the total ecosystem depends on the magnitude of the disturbance created. Obviously, concurrent dredging and dike construction operations would create the maximum disturbance at the proposed project site.

Turbidity. The degree of turbidity and associated effects depends upon the natural clarity of the water, the type of suspended solids, the material dissolved in the water, and the duration of the suspension. Turbidity in the water column from an isolated dredging activity under normal oceanographic conditions persists throughout the dredging operation, with highest turbidity values adjacent to the dredge. Within a few hours after cessation of dredging, turbidity generally declines to background levels. Throughout the duration of the proposed dredging and dike construction, turbid conditions would tend to persist throughout the water column.

Dredging would have a greater impact when the water was low in salinity, typically during rainy periods. Salinity affects flocculation, owing to seawater's high ionic strength, and the change causes different settling rates.

Low temperatures and high salinity result in a higher water density, which can also keep more suspended matter in the water column. This effect becomes prominent during periods of stratification.

It is doubtful, however, that salinity, temperature, and density contribute measurably to the distribution of suspended dredged material when compared to current and wave activities.

Data from sediment core and benthic surveys, displayed in Figure 2.1.4.1-4, reveal that surface sediments in the proposed dredging area are primarily composed of Group B (49 percent sand and 51 percent silt) and Group C (76 percent sand and 24 percent silt). However, the average fraction retained on a No. 200 sieve for core samples at Stations 24, 25, 40, and 41 in the proposed dredging area is below the Spencer Classification for sand.

Turbidity and sediment effects on the marine environment from offshore dredging of sand are to be considered generally insignificant and short-term. However, dredging of fine-grained substrate would create a more persistent turbidity plume. Long-term turbidity problems can result from resuspension of fine-grained materials through wave and/or current action.

Metal and nutrient release. A major concern during dredging operations is the release of trace contaminants and nutrients from the disturbed sediments. Sediments are known to contain the major fraction of trace metals, nutrients, and chlorinated hydrocarbons in aquatic environments.

Most metal cations and nutrients exist in several forms which differ in toxicity and availability. Basically, the fraction of a chemical constituent available for release into the water column upon sediment disturbance is dependent upon the interstitial water concentration and the easily exchangeable fraction in the sediment. Sorptive behavior and redox (oxidation-reduction) reactions of various chemical constituents occurring within sediments during dredging govern to a large extent the distribution of chemical constituents among various available and nonavailable forms. The fraction of the interstitial waters and water-soluble phase of metals in the sediment is considered to be immediately available for biological uptake upon resuspension of the sediments.

Experiments conducted at research facilities have determined that oxygen content was one of the dominant factors controlling the release of heavy metals from sediments. Long-term exchange studies by the Corps of Engineers have determined that, under oxidizing conditions, the concentrations of most trace metals in the interstitial waters and water-soluble phase increased; under reducing conditions, little increase was observed.

In general, laboratory findings show that apprehension regarding the release of a significant quantity of toxic material into solution during dredging operations are unfounded. Whereas some trace metals may be released in the parts per billion (ppb) range, others show essentially no release patterns. Most of the concentrations in the soluble phase are well below the current water quality criteria. In addition, there is no indication from experimentation that dredge operations directly influence uptake of toxic constituents. Therefore, short-term effects of metal and nutrient releases from resuspended sediments in the aquatic ecosystem are unlikely to have any significant impacts.

Ammonia and organic nitrogen are the two nitrogen compounds of greatest potential significance to water quality at the dredging site. Organic nitrogen is generally found in particulate form; therefore, if suspended, it would settle out more quickly than ammonia, which is present in both dissolved and sorbed states.

Phosphorus is present in a variety of inorganic and organic forms and can be released in large quantities under reducing conditions. Finer sediments release comparatively more nutrients than do coarser sediments due primarily to the finer particle size and higher organic content of the finer sediments. Silty and sandy sediments released nutrients at levels 2 to 10 times lower than did clayey sediments. Generally, silty clay-content sediments released higher concentrations of nutrients and lower concentrations of trace metals and at levels that could greatly increase autotrophic activity (inorganic utilization as food) (Chen et al., 1976).

Effects of dredging on the water column should have no measurable impact on abiotic parameters, with the possible exception of dissolved oxygen. Resuspended material can exert a biochemical oxygen demand (BOD), which will consume oxygen at varying rates and to varying degrees, depending on prevailing conditions. This situation could persist throughout the proposed construction period.

Freshwater quality would not be affected. All construction would be above freshwater aquifers, which are currently unfit for consumption because of previous saline intrusion. Groundwater quality would not be affected. Groundwater levels lie at elevations significantly beneath the project site and are not subject to intrusion.

3.1.5.1.2 Operation

Operation of the tanker route from Port Valdez to Long Beach would result in impacts from tanker discharges, oil spills, and tanker accidents. Nearshore pollution sources, municipal waste water and industrial effluents, are not anticipated to increase because of the project. Since the most significant potential impacts would result from oil spills, much of this section will discuss four areas: (1) the probability of an oil spill, (2) the physical and chemical fate of the oil, (3) the possible oil spill trajectories along the route, and (4) the impacts on the water quality.

In addition, short discussions of impacts due to human waste and daily waste discharges from tankers are included.

Ocean

Waste discharges. Normal tanker operations generate potential pollutants such as sewage, domestic waste, dry garbage, and oily waste that can affect the quality and use of water resources if not controlled.

Sewage means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body wastes. Sewage is expected to be generated on a SOHIO ship at the rate of about 1,000 gallons (3,785 liters) per day. The total sewage generated by the fleet would be about 11,000 gallons (41,600 liters) per day. Discharge of this small volume in open ocean areas poses an insignificant impact to water quality. Within navigable waters of the United States, federal legislation prohibits the discharge of untreated or inadequately treated sewage. During transit of these waters, tankers would retain these wastes on board for discharge to shoreside facilities at terminals or in open ocean areas.

Domestic waste is wastewater from laundries, galleys, showers, sinks, etc. The wastewater includes concentrations of laundry detergents and liquid garbage. Domestic waste would be generated on a SOHIO ship at the rate of about 1,000 gallons (3,785 liters) per day. The total volume of domestic waste generated daily by the SOHIO fleet would be about 11,000 gallons (41,600 liters). Discharge of this small volume in open ocean areas would not result in significant water quality impacts. In navigable waters of the United States, domestic wastes would be stored in holding tanks for later discharge in open ocean regions or to treatment facilities at the terminals.

Garbage would be generated aboard each SOHIO ship at the rate of about 150 pounds (68.1 kgs) per day for a daily total of 1,650 pounds (750 kgs) for the fleet. It would be disposed of in various ways. In open ocean areas, overboard discharge would be used. Although aesthetically unpleasant, this volume would not be a significant impact. Along coastal areas and in navigable waters of the United States, garbage would be retained on board for disposal at terminals or discharged overboard when open ocean areas were reached.

Oily waste is produced by oil leaks from operating machinery in engineering areas and from tank cleaning operations. Machinery oil leaks collect in the ship's bilges along with water. The mixture is allowed to be discharged overboard when ships are more than 12 miles from the nearest land, providing the effluent content is less than 100 parts per million (USCG, 1975). In coastal waters, the oily waste would be pumped to holding tanks for later discharge to treatment facilities at shore terminals or at sea. The volume of oil in this oily waste discharged to open oceans from this source is difficult to support by measured data. Estimates range from several barrels annually per ship to as high as 70 barrels (NAS, 1975). Even at the higher level of discharge, the effect on water quality or use would not be significant.

Oily waste is also generated from tank cleaning operations. After discharging cargo, a tanker without exclusive segregated ballast must take sufficient sea water into the cargo tanks to ensure proper propeller immersion and to provide handling and sea-keeping characteristics. The weight of ballast taken on board depends on the weather conditions anticipated along the route. It can amount to half the loaded deadweight, although lesser amounts are often adequate. SOHIO tankers would have segregated ballast ranging from 20 to 35 percent of loaded deadweight ratings. It can be expected, therefore, that ballast in cargo tanks would be required at times when severe sea conditions are anticipated.

When ballasting of cargo tanks is required, it is likely that the cargo tank walls would be cleaned by high pressure water jets before sea water was allowed to enter the tank. The oily mixture that results from the tank cleaning would be stored in an empty cargo tank or "slop tank." As separation takes place, the vessel may discharge the underlying water (USCG, 1975) provided the vessel:

1. Is more than 50 nautical miles (92.6 km) from land.

2. Is proceeding en route.

3. Is discharging at an instantaneous rate of oil content not exceeding 0.37 bbl (60 l/nautical mile).

4. Does not exceed 1/15,000 of the total quantity of the cargo that the cargo was a part (pre-1977 vessels) or 1/30,000 of the total quantity of the cargo for new vessels.

A reasonable value of oil discharged as a result of tank cleaning can be derived by recognizing that the "new" vessels would probably not have to ballast to cargo tanks in 80 percent of the trips. This reduces the volume of oil discharged by the class to 5,015 barrels annually. This represents about 0.02 percent of the 1973 annual input rate of 2.2 million barrels for tankers using these procedures. In practice, the oil discharged to the ocean from vessels returning to Port Valdez might be reduced to zero because of the availability of dirty-ballast treatment facilities at Port Valdez.

The small volume of oil discharged to the ocean by this practice, as well as the fact that the discharge would be limited to regions beyond 50 miles and would be distributed along the track, indicates that the environmental impact to water quality and use would be negligible in the short-term and most likely not significant in the cumulative sense.

Probability of an oil spill. The following discussion is derived mainly from the "Tanker Traffic Study: Valdez to Long Beach" (Socio-Economics Systems, 1976) and "SOHIO Crude Oil Transportation System Tanker Traffic Study" (Environmental Research and Technology, 1976). The latter study has been updated (March, 1977) to include additional data on iceberg damages. The study is presented in Appendix A1.1.1.1-A of the FES.

It should be pointed out that although the following discussion of accident rates and spills is based on the proposed SOHIO tankers and oil throughput, it is expected that the transportation of a similar amount of oil by similar vessels will occur without the proposal (see Section 2.2.5.1). Thus, in this sense no incremental change in hazards or impacts would be attributable to strictly the SOHIO proposal.

The Sea Leg (the tanker route from Valdez to Long Beach) would involve a mix of 11 tankers, as proposed by SOHIO, transporting 700,000 bbl/d. Use of an additional three tankers is likely, according to BLM analysis. Table 1.1.1.1-1 summarizes the vessels, their characteristics, and owners. The down-coast voyage would take five days, with loading and unloading requiring two days. A complete round trip, therefore, would take approximately 14 days.

A detailed forecast of ship traffic was not necessary since tanker casualties are not a function of total traffic density, but are proportional to the number of tanker voyages made (Oceanographic Institute of Washington, 1974). Forecasts for the year 2000 predict that total traffic (tanker and nontanker) along the sea routes between Valdez and San Pedro Bay would increase threefold, and traffic in the Gulf of Alaska would be five times the 1975 level. Intuitively, the increase in traffic volumes and movements suggest an increased risk of ship accidents.

Not all tanker accidents lead to oil spills, and the variability of oil spills is large. Worldwide statistics are higher than the U.S. rates in both number of ships lost and gross tonnage.

The nationwide tanker accident rate per trip is about 4.4 per 1,000 trips, and the rate for accidents in port areas is about 2.65 per 1,000. The variations for different Pacific ports are shown in Table 3.1.5.1.2-1. The Port of Long Beach has a very low accident rate. One collision and three rammings were reported by the Coast Guard during the period, Fiscal Years 1969 through 1975.

Table 3.1.5.1.2-1

Specific Ship Accident Data

LOCATION	Rate (per 1,000 trips)	Source and Comments
Cook Inlet	7.0	FPC[a] - Tankers only
Valdez	5.9	FPC - Tankers only
Puget Sound	6.6	USCG[b] - All ships
Puget Sound	5.3	OIW[c] - Tankers only
San Francisco Bay	5.7	USCG - All ships
San Francisco	6.8	OIW - Tankers only
Los Angeles/Long Beach	3.7	USCG - All ships
Los Angeles/Long Beach	2.3	OIW - Tankers only
Los Angeles Harbor	1.9	USCG - Tankers only
Los Angeles Harbor	2.4	OIW - Tankers only

Source: Federal Power Commission, 1976. Alaska Natural Gas Transportation System, FEIS, App. A, Vol. 1. U.S. Coast Guard, 1972. Oceanographic Institute of Washington, 1974.

[a] Federal Power Commission.

[b] U.S. Coast Guard.

[c] Oceanographic Institute of Washington.

A significant factor in the observed low accident rate in Long Beach is the private Vessel Traffic System (VTS) installed and operated by the contract pilot service. The service operates two radars and has bridge-to-bridge and bridge-to-shore radio communications.

The use of VTS in reducing accidents is not as effective in coastal waters as it is in harbors. The Santa Barbara Channel uses a traffic separation system with the northbound lane inshore and the southbound traffic lane to the west. Each lane is 2 nautical miles wide, and is separated by a zone 1 mile wide. A VTS is under construction for Prince William Sound and Valdez, and would probably reduce the accident rate there.

Table 3.1.5.1.2-2 gives the projected tanker accidents from Valdez to Long Beach over a 10-year period. Overall, there would be about 2.3 accidents per year with a throughput of 700,000 bbl/d. The study prepared for BLM by Environmental Research Technology, Inc. also discusses in detail probabilities and volumes of oil spills in Appendix A1.1.1.1-A.

Table 3.1.5.1.2-2

Projected SOHIO Tanker Accidents

in a 10-Year Period (Location)

ACCIDENT CAUSE	Prince William Sound (Valdez)	At Sea	Santa Barbara Channel	San Pedro Bay (Long Beach)
	MMbbl/d[a] 0.7	MMbbl/d 0.7	MMbbl/d 0.7	MMbbl/d 0.7
Collisions, rammings, groundings	9.4	0.3	2.5	3.1
Structural failures	0.1	3.3	0.1	0.0
Fires, explosions, breakdowns	1.1	2.4	0.6	0.4
Total	10.6	6.0	3.2	3.5

Source: Socio-Economics Systems, 1976.

[a] Million barrels per day throughput.

Table 3.1.5.1.2-3 gives the projected tanker accidents over 10 years, from Valdez to Puget Sound and San Francisco. The high number of accidents projected is largely a result of the number of predicted trips between Valdez and San Francisco. San Francisco is depth-limited to tankers with a maximum of 50,000 DWT. Delivery of 325,000 bbl/d would require an estimated 12 vessels and 372 trips per year. Puget Sound, with deeper water, could accommodate larger tankers (180,000 DWT). With larger vessels and fewer departures, the number of accidents would drop accordingly.

Table 3.1.5.1.2-3

Projected Tanker Accidents Over 10 Years, Valdez to Puget Sound and San Francisco[a]

ACCIDENT TYPE	Valdez	At Sea	Coastal Waters	Puget Sound	San Francisco Bay
Collisions, rammings, groundings	18.9	0.4	3.82	1.5	16.8
Structural failure	0.1	4.9	0.1	0.0	0.1
Fires, explosions, breakdowns	1.1	3.7	0.9	0.1	1.0
Total	20.1	9.0	4.82	1.6	17.9

Source: Socio-Economics Systems, 1976.

[a] Assuming 100,000 bbl/d to Puget Sound; 325,000 bbl/d to San Francisco.

Many sources introduce oil pollution into the oceans. An estimated 11 percent of the nearly 5 million metric tons per year of oil pollution is the result of vessel casualties. Operational spills, from such causes as bilge pumping, leaks, and spills during bunkering and tank cleaning account for another 36 percent of the oil pollution. Tanker cleaning and bilge pumping are not used for oil spill analysis for this proposal as the cleaning would not take place during normal operation, and bilge pumping would be handled through a bilge-water reclamation facility constructed at Valdez, Alaska. Nonmarine operations (refineries, industrial machinery, motor vehicles) account for 51 percent of the oil spilled (Porricelli and Keith, 1974). Oil pollution from tankers only is presented in Table 3.1.5.1.2-4. The standard estimate for oil pollution resulting from discharges and terminal operations in port areas is one-half barrel spilled per million barrels handled (U.S. Coast Guard, 1972). The Port of Long Beach has experienced a lower rate with less than one-tenth barrel spilled per million barrels (Allan Hancock Foundation et al., 1975).

Table 3.1.5.1.2-4

Sources of Oil Pollution From Tankers

CAUSE	Annual Outflow[a]	Percent
Tank cleaning	967,000	69.7
Discharges[b]	100,000	7.2
Terminal operations	70,000	5.0
Casualties	250,000	18.0
Total	1,387,000	99.9

Source: Porricelli and Keith, 1974.

[a] Metric tons.

[b] Includes bilge pumping, leaks, and bunkering spills.

Oil spill data show a wide range of spill size, depending on the type of accident and its location. However, more than 90 percent of spills are smaller than 1,000 gallons (about 25 barrels) and more than 50 percent are smaller than 15 gallons (about .36 barrel). On the other hand, most of the oil spilled comes from a few very large spills (up to 1 million barrels or more).

The accident location and the amount of spillage are not directly correlated (Table 3.1.5.1.2-5). Accidents at sea contribute a larger share of spillage while spillage in harbors results in relatively smaller amounts.

Table 3.1.5.1.2-5

Accident Location and Oil Spillage

ACCIDENT LOCATION	Percent of Accidents Involving Spills	Percent of Total Oil Spillage
At sea	19.5	55.7
Coastal	22.6	14.1
Entrance	22.2	19.3
Harbor	16.9	5.3
Pier	16.2	4.5

Source: Porricelli and Keith, 1974.

Tables 3.1.5.1.2-6 and 3.1.5.1.2-7 present the annual statistical probabilities of oil spills and the projected average spill size over the proposed route. The most significant feature of these tables is that the addition of total vessel losses to other spills only slightly changes the probabilities, but increases the average volumes spilled by at least an order of magnitude. Additional data and methodology used in determining accident and spill probabilities is contained in the Tanker Traffic Study in Appendix A1.1.1.1-A.

Table 3.1.5.1.2-6

Probability Per Year of Spills

SPILL LOCATION	Probability	
	Less Than Total Loss	All Spills[a]
Prince William Sound (Valdez)	0.11	0.12
Prince William Sound to San Francisco	0.13	0.14
San Francisco to San Pedro Bay	0.077	0.086
San Pedro Bay (Long Beach)	0.037	0.040
Total	0.35	0.39

Source: Environmental Research and Technology, 1976.

[a] Average spill volume in barrels.

Table 3.1.5.1.2-7

Average Annual Spill Volume

SPILL LOCATION	Probability	
	Less Than Total Loss	All Spills[a]
Prince William Sound (Valdez)	389	6,730
Prince William Sound to San Francisco	439	7,333
San Francisco to San Pedro Bay	302	3,883
San Pedro Bay (Long Beach)	130	2,243
Total	1,260	20,189

Source: Environmental Research and Technology, 1976.

[a] Average spill volume in barrels.

Two hazards potentially affecting tanker traffic to and from Port Valdez through Prince William Sound have received considerable publicity: the constriction of Valdez Narrows (due to the presence of Middle Rock) and the presence of icebergs in the shipping lanes in Valdez Arm. These two subjects are discussed in detail in Appendix A1.1.1.1-A.

The ERT study concludes that based on experiences in similar, if not more constricted, approach channels to other world tanker ports, it does not appear that Valdez Arm and Valdez Narrows present an unusual or high potential for grounding, provided that vessels do not traverse the passage during high wind-speed conditions. Although the exact timing of strong wind gusts may be difficult to predict or report, the synoptic conditions which produce these high winds are readily predicted and rapidly dissipate.

Present numbers of icebergs which have been observed drifting from Columbia Glacier into the proposed tanker route through Valdez Arm do not generally appear to represent a significant hazard. However, on at least one occasion the numbers of icebergs observed in the Arm would significantly increase the probability of tanker collisions with icebergs. There is some evidence to indicate that Columbia Glacier may be entering an unstable condition wherein the numbers of icebergs present in the Arm would increase substantially. Should this occur the probabilities of collisions with oil tankers would increase dramatically.

Several factors would affect the impacts of iceberg-tanker collisions. There are no available data on the relationship of tanker-iceberg collisions and oil spills. Not all, and perhaps very few, collisions would result in tanker damage or spills. The size of potential icebergs and their potential for damaging tankers is not known. In addition, the potential of navigational controls, such as iceberg warnings, towing of icebergs out of the lanes, or the temporary shutdown of traffic would reduce collision probabilities. Ship structures such as double hulls or reinforced bows might also be a significant factor in reducing the potential of oil spills should collisions occur.

In summary, should Columbia Glacier enter an unstable condition (retreat), tanker-iceberg collisions would be highly probable in the absence of mitigating factors. Although the relationship is not known, some increase in the probabilities and sizes of annual oil spills in Prince William Sound could be expected. These accidents could occur whether or not this project is implemented, since oil will be transported by tanker with or without the SOHIO project, once the Trans-Alaska pipeline is operational.

Summary. Accident rates for the tanker fleet would be dependent on the number of tanker voyages made. The number of voyages, in turn, would be determined by the amount of crude oil carried. At the proposed level of 700,000 bbl/d throughput of Alaskan crude oil, the accident rate is expected to average 2.3 accidents per year. Oil spills do not always result from accidents.

Oil spills are expected from both operational sources and tanker accidents. Operational spills are expected to occur rather frequently, approximately 23 per year at 700,000 bbl/d throughput. The amount spilled would be relatively small, however, with an estimated seven barrels per spill, distributed about equally between each port area and the open sea. Accidents leading to spills, while much rarer, result in much larger amounts spilled. A study prepared for BLM by ERT, Inc. indicates a probability of 0.56 in the 25-year project life that a tanker would be a total loss; i.e., a catastrophic spill occurrence. To state this another way: A major spill from tanker loss is predicted once in 85 years. In years without a major spill, statistics indicated that annual spills of 389 barrels would occur in Prince William Sound, 302 bbls/yr would occur between San Francisco and San Pedro Bay, and 130 barrels would be spilled in San Pedro Bay.

Physical and chemical fate of oil. Petroleum is made up of thousands of hydrocarbon, nitrogen, sulfur, oxygen, and trace metal components, of which hydrocarbons form the greatest percentage. The hydrocarbons are in turn composed of different subgroups based upon their structure: paraffins (alkanes), cycloparaffins (naphthenes), aromatics, and naphtheno-aromatics. The designation of any petroleum substance as gasoline, fuel oil, or crude oil depends on the relative percentages of the above-mentioned fractions and the nitrogen, sulfur, and oxygen (NSO) compounds it contains. Table 3.1.5.1.2-8 illustrates this variability of components among different crudes and distillation products, and Tables 3.1.5.1.2-9 and -10, the typical properties of Prudhoe Bay crude oil.

Table 3.1.5.1.2-8

Estimated Composition by Weight for Various Petroleum Substances

PETROLEUM PRODUCTS	Fractions			
	Paraffins	Cycloparaffins	Aromatics	NSO[a]
Heavy crude	10%	45%	25%	20%
Average crude	30%	50%	15%	5%
No. 6 fuel oil[b] (Bunker C)	15%	45%	25%	15%
No. 2 fuel oil[c]	30%	45%	25%	0
Gasoline	50%	45%	10%	0
Kerosene	35%	50%	15%	0

Source: Adapted from the National Academy of Sciences, 1975.

[a] Nitrogen, sulfur, oxygen compounds.

[b] No. 6 fuel oil (Bunker C) is used for fueling ships.

[c] No. 2 fuel oil is used for home heating.

Table 3.1.5.1.2-9

Properties of Prudhoe Bay Crude Oil

PHYSICAL PARAMETERS	Ranges
API° gravity	27
Pour point °F	15-30
Total sulfur (wt %)	0.95-1.05
Specific gravity (60°F)	0.893
True vapor pressure	7.5 to 9.5 psia[a]
Viscosity SSU[b]	
@ 60°F	200
@ 100°F	85

Source: Williams Brothers, 1976.

[a] As delivered to West Coast.

[b] Saybolt Seconds Universal: the time in seconds for 60 ml of fluid through capillary tube of Saybolt Viscosimeter at a given temperature.

Table 3.1.5.1.2-10

Fractional Composition of Prudhoe Bay Crude Oil

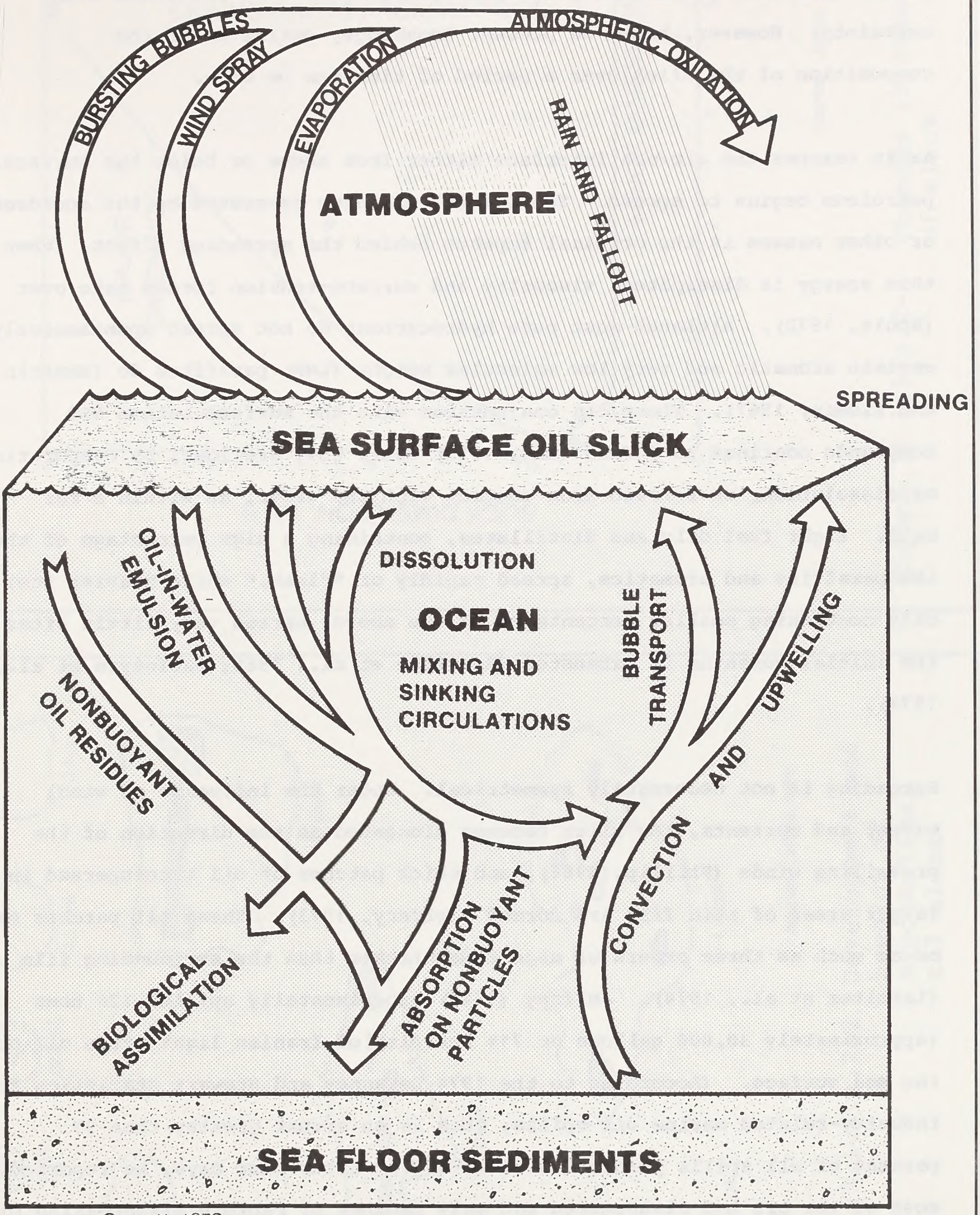
FRACTION AND BOILING RANGE	% Vol in Crude	Vol % Composition Paraffins	Aromatics	Naphthenes	Sulfur (% by wt)
Naphtha 55°-400°	19	45	15	40	0.02
Kerosene 340°-520°	17	32	25	43	0.15
Gas oil 520°-600°	8.4	32	31	37	0.5
Gas oil 600°-700°	10.7	20[a]	38[a]	42[a]	0.8
Heavy distillates 520°-1100°	51	17[a]	41[a]	42[a]	1
Bottoms 1100°+	17	10[b]	50[b]	40[b]	2.1

Source: Williams Brothers, 1976.

[a] Weight percentage.

[b] Estimated.

Once entrained, the petroleum is subject to many different physical, chemical, and biological processes that modify the original composition. The processes include spreading, evaporation, dissolution, biodegradation, emulsification, oxidation, and sedimentation (Figure 3.1.5.1.2-1). The rates of each are determined by the nature of the spilled oil and the temperature, nutrient level, light intensity, winds, currents, particulate matter, etc., that exist at the time. This constant removal and transformation process is called "aging" or "weathering," and the final residue depends upon the original starting material and the conditions of the sea and atmosphere during its sojourn. The actual rates for most of these processes have not been determined because of difficulties in designing experiments that would generate accurate, unbiased data and in measuring certain parameters during actual spills (Feldman, 1973). Until these rates and the relationships among the processes are determined, the



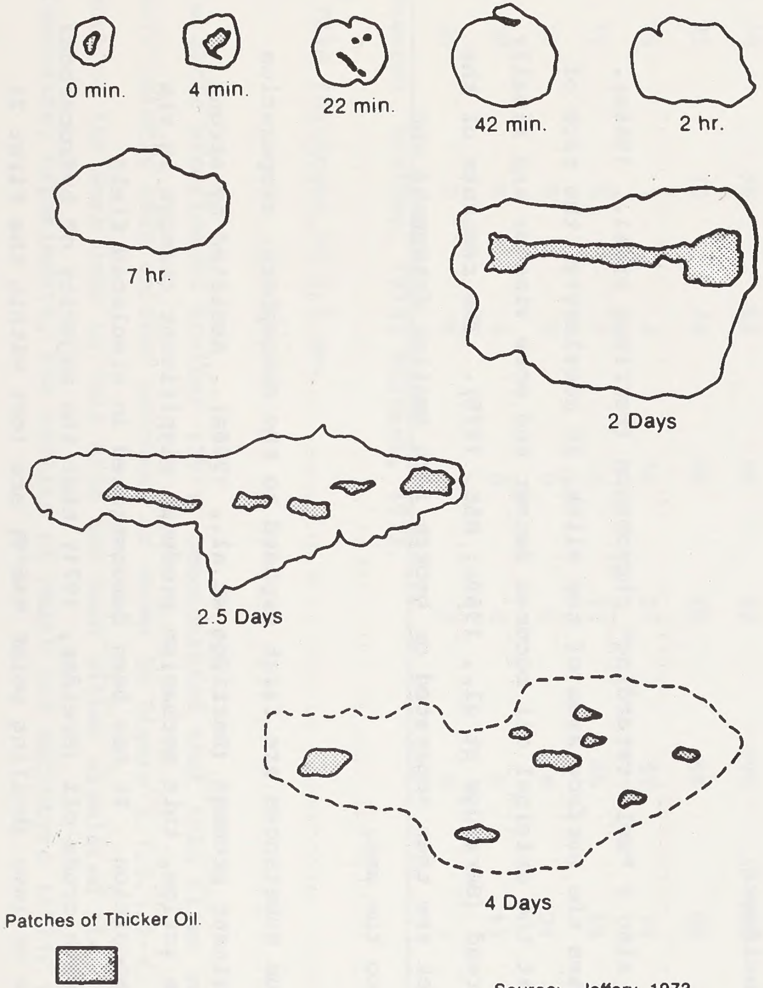
Source: Garrett, 1972

Figure 3.1.5.1.2-1 Natural forces that disperse and modify petroleum slicks on water

actual fate of a particular petroleum species cannot be predicted with certainty. However, based on present knowledge, estimates of the composition of the slick over a period of time can be made.

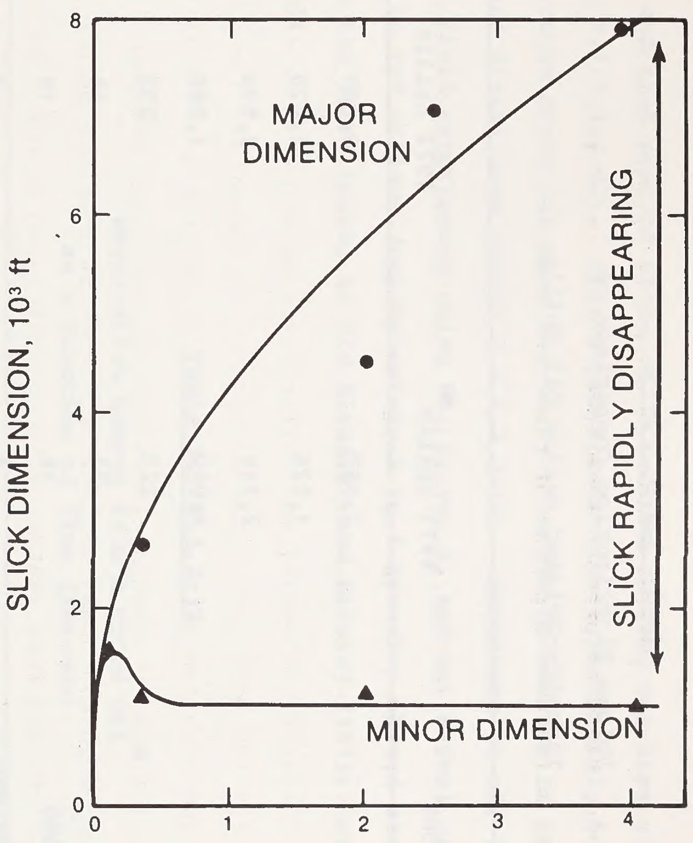
As it reaches the air/sea interface either from above or below the surface, petroleum begins to spread. The initial momentum generated by the accident or other causes is the original impetus behind the spreading effect. When this energy is dissipated, viscosity and surface-tension forces take over (Hoult, 1972). Although most pure hydrocarbons do not spread spontaneously, certain aromatic and very low molecular weight (LMW) paraffins do (Shafrin and Zisman, 1967). These, in conjunction with the surface-active NSO compounds continue to spread (NAS, 1975) until they are lost, by evaporation or dissolution, or removed from contact with the water, as within a tar ball. Light fuel oils and distillates, containing a high percentage of the LMW paraffins and aromatics, spread rapidly or "flash," while heavier fuel oils containing smaller percentages of the above, spread very little after the initial momentum is exhausted (Berridge et al., 1968; MacIntyre et al., 1974).

Spreading is not necessarily symmetrical. Under the influence of wind, waves, and currents, the slick becomes elongated in the direction of the prevailing winds (Phillip, 1966), and thick patches of oil interspersed in larger areas of thin film are formed (Jeffery, 1973). These oil patches may be as much as three orders of magnitude thicker than the surrounding film (Lassiter et al., 1974). Jeffrey (1973) experimentally spilled 120 tons (approximately 30,000 gallons or 714 barrels) of Iranian light crude oil on the sea surface. (According to the 1974 DeVanney and Stewart statistics for industry-related marine oil spills, this is an amount greater than 99 percent of all spills [Table 3.1.5.1.2-11].) After four days, he reported, most of the oil had disappeared and only patches of rapidly disappearing oil remained (Figures 3.1.5.1.2-2 and 3.1.5.1.2-3).



Source: Jeffery, 1973

Figure 3.1.5.1.2-2 Development and breakup of hypothetical oil slick



Source: Jeffery, 1973

Figure 3.1.5.1.2-3 Changes in dimensions of slick

Table 3.1.5.1.2-11

Volume Distribution Comparison of

Industry-Related Marine Oil Spills

NUMBER OF GALLONS	1971 Spills[a]	1972 Spills
0 - 1	2,497	2,387
1 - 10	1,526	2,020
10 - 100	2,146	2,509
100 - 1,000	1,000	1,068
1,000 - 10,000	222	232
10,000 - 100,000	53	54
100,000 - 1,000,000	16	14
1,000,000 - 10,000,000	1	3
10,000,000	0	0
Total	7,461	8,287

Source: DeVanney and Stewart, 1974.

[a] Number of incidents.

Spreading is also a "self-retarding" phenomenon (Berridge et al., 1968a). As it increases the surface area of the slick, it accelerates the rate of change so that the original oil becomes denser and more viscous and finally ceases to spread (Berridge et al., 1968a; NAS, 1975). The remnants of the original slick are then separated or broken into smaller fragments and dispersed into the sea.

When petroleum substances are first exposed to the atmosphere, evaporation is the predominant process (Berridge et al., 1968a). Assisted by strong wind and wave action, this mechanism produces significant changes in the petroleum composition. It has been demonstrated in simulated field experiments with crude oil (Kreider, 1971) that the majority of hydrocarbons of 12 carbons or less (boiling point 446°F) are lost within the first 24 hours and that most of those of 15 carbons or less are lost within 10 days (Table 3.1.5.1.2-12). This would account for approximately 50 percent of the average crude oil mass and an even larger percentage of the lighter fuel oils and distillates (Table 3.1.5.1.2-12). MacIntyre et al. (1974) in actual field experiments using No. 2, No. 4, and No. 6 fuel oils in volumes of 60 to 200 gallons (approximately 1 to 6 barrels) showed similar losses during the first hours, as did Sivadier and Mikoloj (1973) using natural seep oil.

Table 3.1.5.1.2-12

Evaporative Losses From a Crude Oil[a]

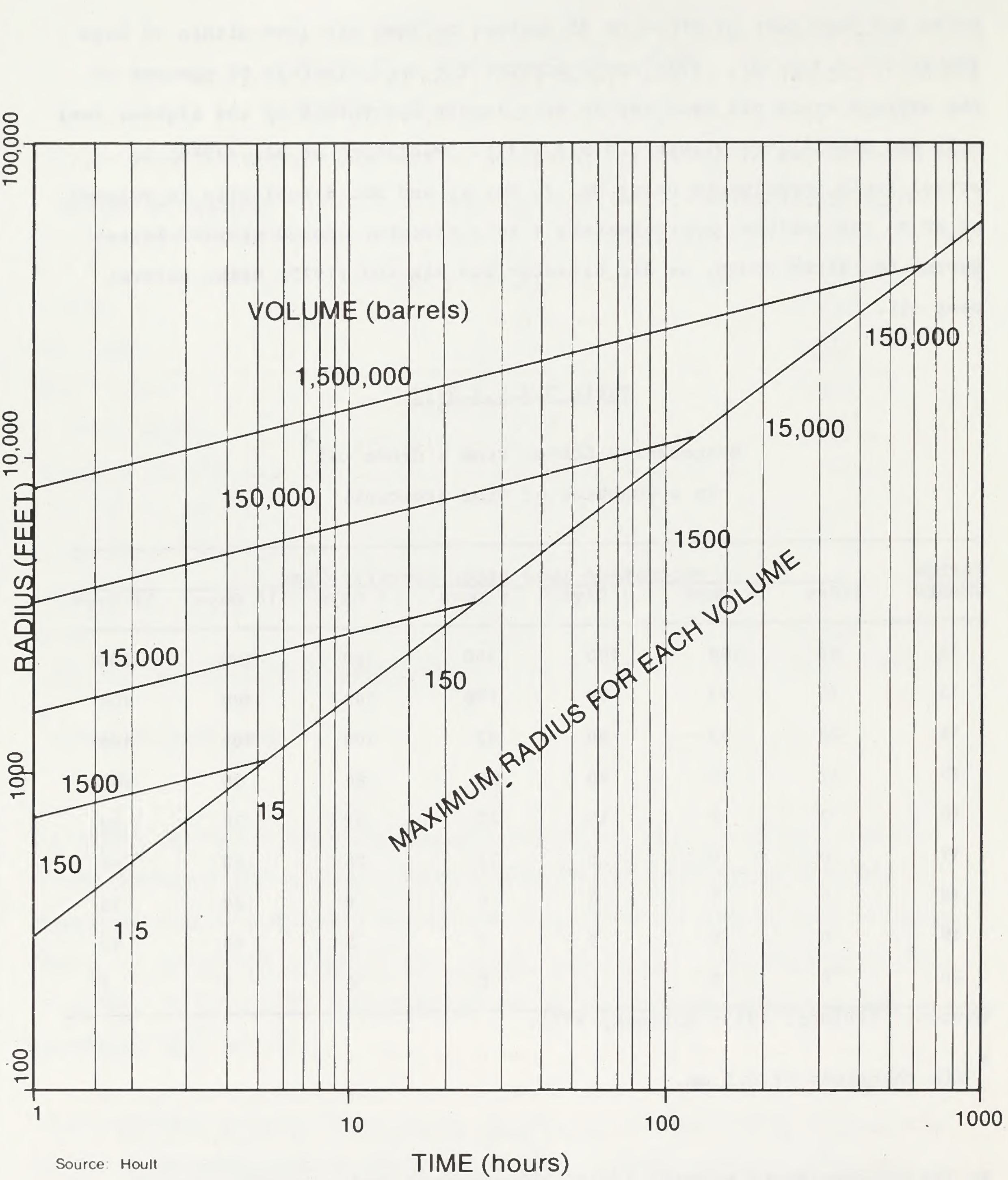
as a Function of Time (Percent)

CARBON NUMBER	Percentage Loss After Specific Time						
	1 Day	2 Days	3 Days	4 Days	7 Days	10 Days	21 Days
12	98	100	100	100	100	100	100
13	75	91	98	100	100	100	100
14	38	52	80	92	100	100	100
15	12	18	40	55	84	95	100
16	1	2	15	27	52	74	88
17	0	0	5	11	25	40	58
18	0	0	0	0	8	24	35
19	0	0	0	0	5	13	13
20	0	0	0	0	0	3	3

Source: Kreider, 1971; Kolpack, 1973.

[a] Film thickness of 0.5 mm.

In later experiments Kreider (1971) demonstrated that thin films weather more quickly than thicker patches, as shown in Figure 3.1.5.1.2-4. Since much of the work done in this area has been either simulated field or laboratory experiments, the results of Smith and MacIntyre (1971) should be



Source: Hoult

Figure 3.1.5.1.2-4 Radii of oil slicks as a function of time and volume spilled

noted. Comparing losses of No. 2 fuel oil components in a laboratory bubbler apparatus and in the field, they found that losses of LMW hydrocarbons were significantly greater in the field (Table 3.1.5.1.2-13). Loss of these LMW paraffins and aromatics implied the loss of the more toxic components of oil (Blumer, 1969, 1971; Anderson, 1975).

Table 3.1.5.1.2-13

Evaporative Losses From a No. 2 Fuel Oil

CARBON NUMBER	Percentage 6 hr, 41°F (5°C)[a]	 Bubbler, 40 hr, 77°F (25°C)[b]
10	96	81
11	85	46
12	58	20
13	44	6
14	7	0
15	6	0

Source: Smith and MacIntyre, 1971.

[a] Wind 1 to 18 knots.

[b] Film thickness 0.5 mm, 2 liters per minute air.

After the lower molecular weight hydrocarbons have evaporated, the rate of loss by evaporation stabilized (Blumer et al., 1973). High molecular weight (HMW) hydrocarbons in the C_{15} to C_{25} range (boiling points 446° to 752°F, 230° to 400°C) evaporate much more slowly while those greater than C_{25} with boiling points >752° (400°C) scarcely evaporate at all and remain in the slick, subject to modification by other processes. As a result of this change, the original oil becomes denser (Berridge et al., 1968a; Sivadier and Mikolay, 1973) and the specific gravity of crudes and heavier fuel oils approaches that of seawater (1.025). If this occurs, the oil achieves a state of near neutral buoyancy and enters the water column via wave action or attachment to existing particulate matter.

Dissolution preferentially removes the LMW aromatics and paraffins (McAuliffe, 1966; NAS, 1975) and is "in competition" with the evaporative loss of these components. These compounds exhibit a wide range of solubilities (benzene, 1,780 gm/10^{6}gm water; toluene, 515 gm/10^{6}gm water; hexane, 9.5 gm/10^{6}gm water [McAuliffe, 1966]) and are responsible for the more immediate toxic effects suffered by the local biota (Blumer, 1969, 1971; Anderson, 1975; NAS, 1975). The HMW aromatics are less soluble, but these may be the compounds responsible for the long-term chronic effects (Blumer et al., 1970, 1972). Other processes, such as oxidation or biodegradation, generate alcohols, phenols, sulfoxides, and so on, which are more soluble than the original components (Berridge et al., 1968a; Zobell, 1950). Dissolution is therefore a longer-term mechanism that continues operating throughout the existence of a spill even after evaporation has stabilized.

Bacteria are widely distributed over the oceans, especially in areas where oil has been spilled (Kolpack et al., 1973). Once considered nuisances because they attacked refined petroleum products, these bacteria now seem particularly useful when oil becomes a problem (Boesch et al., 1974). By converting hydrocarbons to carbon dioxide or other products that may be more soluble in sea water, they eliminate much of the oil residue. Normal paraffins are the most readily degraded components, followed by branched- and cyclo-parrafins and aromatic hydrocarbons (Blumer and Sass, 1972a, 1972b). This preferential loss of normal paraffins leads to a decrease in the "stickiness" of the original oil (Kator et al., 1971).

Biodegradation or microbial utilization is dependent on the nutrient level (nitrogen and phosphorous) and dissolved oxygen content of the water. It is, therefore, more effective in estuaries than in the open ocean and is very slow once the oil has been incorporated into the sea floor or beach sands (Blumer and Sass, 1972a, 1972b). It is also a "surface" phenomenon, which implies that the larger patches of oil are more slowly degraded than the smaller tar balls. Much slower than most of the other processes, biodegradation is the mechanism for destruction of the residue that remains after all other processes are exhausted.

As oil spreads into thin films and thicker patches, the thicker patches begin to take up water at different rates (hours or days) depending on the type of oil (Dodd, 1971). This leads to the formation of water-in-oil emulsions or, with the addition of surfactants or emulsifiers, oil-in-water emulsions. The water-in-oil emulsion, which can contain up to 80 percent water, produces the "chocolate mousse" formations which have been found after some spills (Berridge, et al., 1968a,b; Smith, 1968; Jeffrey, 1973). This type of emulsion can persist much longer than the oil itself on the open sea.

The actual conditions necessary for formation of this type of emulsion are not well understood. Berridge et al. (1968b) tried to duplicate the naturally formed mousses in their laboratory. Using various types of crude oil and Bunker C fuel oil they were able to produce mousses by vigorous agitation of the oils in a bucket. The mousses thus formed were exposed to wind, rain, and gravity and were stable from 1 to more than 100 days depending on the original oil. However, they were unable to produce mousses from the lighter fuel oils and lubricating oils. They concluded, therefore, that the asphaltene fraction, present in the crude and Bunker C oils but absent in the distillates, was reponsible for the mousse formation. (The mousses that were stable in seawater under normal conditions were easily broken down by the addition of surfactants.)

They also concluded that the energy available in wave-cresting and spray-inducing sea movement would be sufficient to form "chocolate mousse" on the open sea, although it has not been found after all spills. The temperatures at which the experiments were performed are not available, but it can be assumed that under the colder water conditions of the North Pacific there would be a somewhat greater tendency than normal for the formation of "chocolate mousse."

By increasing the actual volume of the spilled oil, this type of emulsification can increase the rate of the processes of evaporation, dissolution, and biodegradation, and the density of the remaining oil would therefore increase. Under the influence of wave action, the larger patches of oil thus formed are broken up and can produce the ubiquitous tar balls found in the ocean (Butler et al., 1973; Butler, 1965; NAS, 1975). Those discovered on the open ocean have been determined to have come from one source and have been estimated to remain a year or more (Butler et al., 1973). Those found on beaches are sometimes aggregations of smaller tar balls from different sources (NAS, 1975).

Oil-in-water emulsions are formed by additions of surfactants or emulsifiers and consist of very small particles of oil dispersed in vast amounts of seawater. This type of emulsion is easily dispersed throughout the water column by wave and current action and accelerates the other processes of degradation by increasing the surface area.

Auto-oxidation and photo-oxidation are two other processes that generate more soluble products from the original components (Zobell, 1964; Berridge et al., 1968a). They can be catalyzed or inhibited by trace metals or other components of the oil; e.g., vanadium catalyzes oxidation while sulfur stops it by forming sulfoxide (Dodd, 1971). Here again exact rates are not known, but Freegarde and Hatchett (1970), using light sources resembling sunlight, have estimated that by photolysis alone the time for decomposition of a 2.5 μm slick is 100 hours. This size is equivalent to 2,000 kg/km^2 or approximately 1,300 gal/mi^3 (Garrett, 1969).

The remaining process is sedimentation. As the LMW hydrocarbons evaporate and dissolve and the HMW are degraded, the oil residue becomes denser. When its specific gravity approaches that of seawater, it may be more easily sunk either by agglomeration onto existing particulate matter or by wave action which carries the near neutral buoyancy residue deeper into the water column or forces it into the bottom sediments. Waves and currents may also carry the residue onto beaches where it is either incorporated into the sand or carried out to sea on the next waves. Once oil is incorporated, either in sediments or sands, the rates of change are much slower (Blumer and Sass, 1972a, 1972b). Buried several centimeters beneath the surface sediments, the oil changes very little via the evaporation, dissolution, oxidation, or emulsification mechanisms. Biodegradation, the remaining process, is slowed by lack of nutrients and dissolved oxygen, and the time for degradation lengthens from days and months to years (Kolpack, 1971; Blumer and Sass, 1972a, 1972). Large quantities of oil inundate a beach or are sunk in a specific area can cause erosion and thereby enlarge the affected area by carrying oil farther from the original site (Blumer, 1969, 1971; Blumer and Sass, 1972a, 1972b; Kolpack, 1971). Much work remains to be done to elucidate the effects of oil in sediments, especially in deep sea sediments (NAS, 1975).

In summation, petroleum substances discharged into the ocean are subject to certain physical, chemical, and biological processes that modify the original composition. Volatile, soluble, and easily biodegraded components disappear in several days. The remaining fractions are emulsified and broken into small patches and tar balls and either dispersed in the sea or incorporated into the sediments.

Crude oils and heavier fuel oils in a spill would leave residues that might in time reach the shore while lighter fuel oils and distillates would not. An oil spill that occurs on the open ocean would cause much less damage than one that occurs nearshore since the more immediately toxic components would evaporate or dissolve to form very dilute solutions. If a spill occurs nearshore, the oil that inundates the beaches and marshlands would not have had time to weather, and a greater amount of both immediate and long-term damage would result. The prevailing wind, waves, currents, and distance from shore determine whether or not the spilled oil would reach shore and what its composition on arrival would be.

Oil spill trajectory. The following discussion is derived mainly from reports by Intersea Research Corporation (1974), Devanney (1975), and the U.S. Department of the Interior (1975), and Tetra Tech (1977). Trajectories are discussed for the Prince William Sound area and between Point Conception and Long Beach. Over the remainder of the route, oil spill impacts to coastal areas are considered very remote because of tanker distances from shore and the projected spill life of the oil. Potential trajectories in these areas are estimated, based on currents and winds. Trajectory models usually do not consider the physical, chemical, and biological processes that alter and disperse the spilled oil. Analysis and consideration of these processes are very important when interpreting the potential trajectories, since the processes can rapidly alter and disperse the oil slick until it becomes an unidentifiable patch (Jeffrey, 1973; Gordan et al., 1976).

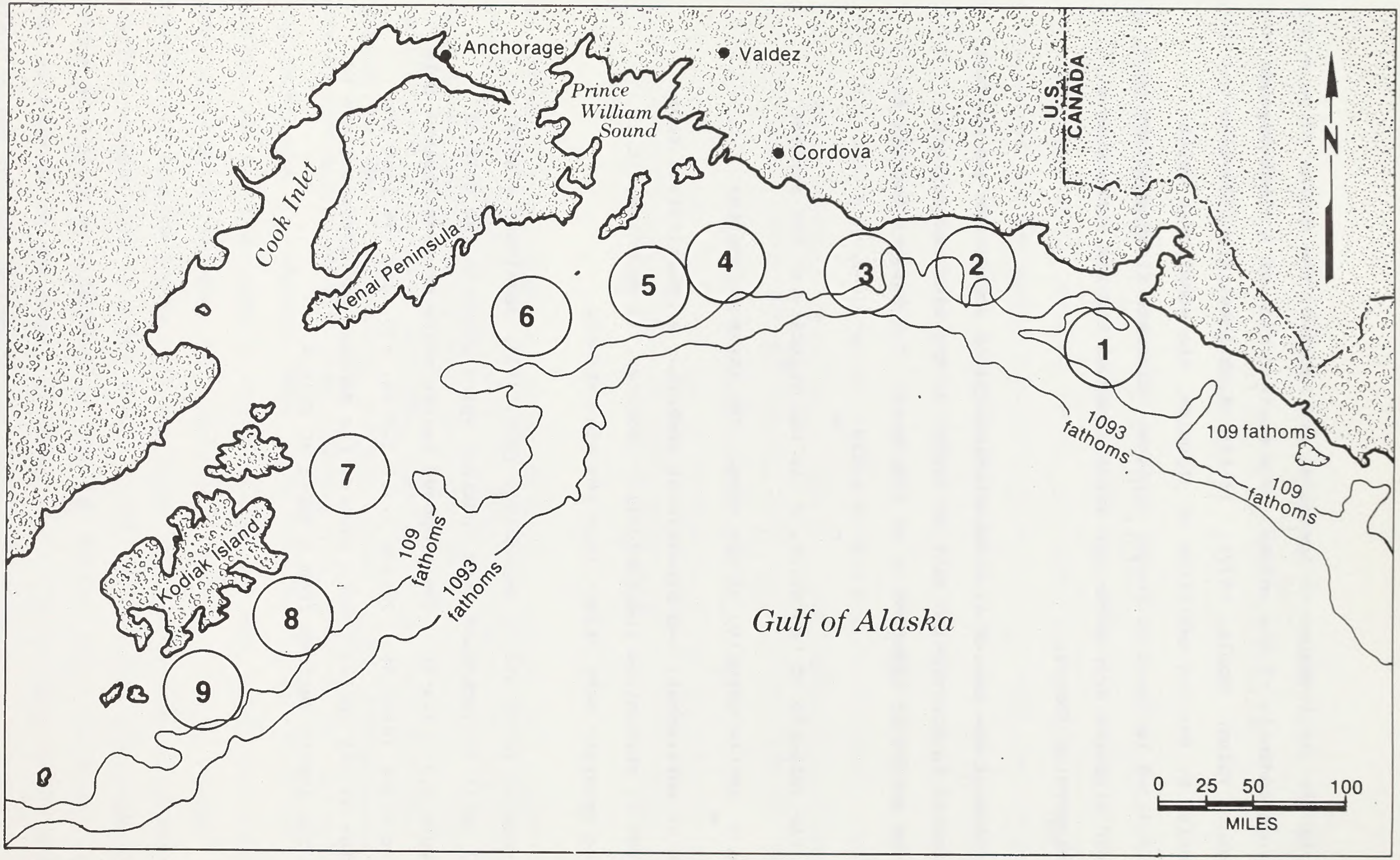
The spread of an oil slick on the undisturbed sea surface is a result of gravitational, inertial, viscous, and surficial factors. Initially, spills would spread because of a balance of gravitational and inertial forces. As the thickness of the slick decreases, viscous forces retard spreading. Finally, for the thinnest slick, surface tension becomes important and the rate of spreading increases until a maximum size is attained. For spills of 100,000 barrels, the inertial phase lasts one hour; for spills of 100 barrels, the inertial phase is much less than one hour, while the viscous phase lasts about one hour; for spills of 10 barrels or less, neither inertial nor viscous phases last very long, and surface tension brings the slick to maximum size in a few hours. Figure 3.1.5.1.2-4 is a graph of the radius of a slick as a function of time for various sizes of spills. The time axis begins at one hour. Therefore, the inertial phase is not shown since volume spilled influences the radius, and separate curves are required. As the final stages of spreading are reached, the radius increases independently of the volume. The maximum size of a slick depends on the original volume (Hoult, 1972). If the slick loses its film-like characteristics by forming emulsions or globules, the model upon which Figure 3.1.5.1.2-4 is based no longer applies. Discrete floating blobs of residue would disperse over wider and wider areas of the sea surface as a result of dispersive forces.

The translation of the center of a hypothetical slick across the sea surface can be estimated in conjunction with knowledge of the wind and current vectors. The motion is referred to as transport. The general formula is:

$$V = V_c + 0.03V_w$$

where V is the velocity of the slick, V_c is the velocity of the surface current and V_w is the velocity of the wind. The three velocities are treated as horizontal, two-dimensional vectors. A contribution from surface waves is recognized theoretically. However, in practice, it is difficult to separate wave effect from the wind effect.

The Massachusetts Institute of Technology (MIT, 1974) developed a model to predict oil spill trajectories from specific spill sites in the Gulf of Alaska (Figure 3.1.5.1.2-5). The proposed tanker route crosses through only one of these sites (Site 4). Tables 3.1.5.1.2-14, -15, and -16 list the probabilities of oil spills coming ashore, the minimum and average times to shore, and the impact regions from a spill at Site 4.



Source: CEQ 1974

Figure 3.1.5.1.2-5 Gulf of Alaska hypothetical oil drilling and spill sites

Table 3.1.5.1.2-14

Probabilities of Oil Spills Coming Ashore at Site 4[a]

SEASON	Distance from Shore (miles) 15	30	45	60
Summer	95-100	95-100	90	80
Winter	55	45	30	20

Source: MIT, 1974.

[a] In percentage of probability.

Table 3.1.5.1.2-15

Minimum and Average Times for a Spill to Reach Shore at Site 4

SEASON	Average (days)	Minimum (days)
Winter	30	7
Spring	29	8
Summer	26	6
Fall	22	7

Source: MIT, 1974.

Table 3.1.5.1.2-16

Summary of Trajectory Summer Behavior, Site 4

IMPACT REGION	Percentage	Av. Days at Sea	Min. Days at Sea
Remained in area	0.00		
Afognak Island	0.00		
North Kodiak Island	0.00		
South Kodiak Island	0.00		
Trinity Island	0.00		
Cape Ignak-Amber Bay	0.00		
Cape Douglas-Cape Igvak	0.00		
West shore of Cook Inlet	0.00		
East shore of Cook Inlet	0.00		
Southern Kenai Peninsula	3.50	43	29
Seward	1.50	36	24
Montague Island	48.00	28	11
Western Prince William Sound	0.50	21	22
Eastern Prince William Sound	1.00	49	37
Hinchinbrook Island-Katella	45.50	21	6
Cape St. Elias-Icy Cape	0.00		
Pt. Riou-Yakutat	0.00		
Yakutat-Cape Fairweather	0.00		
Cape Fairweather-Chichagof Island	0.00		
Nearshore, southeast ocean boundary	0.00		
Southeast ocean boundary	0.00		
Southern portion, southeast ocean boundary	0.00		
Southern portion, southwest ocean boundary	0.00		
Southwest ocean boundary	0.00		
Nearshore, southwest ocean boundary	0.00		

Source: MIT, 1974.

Results of the Intersea Research Corporation study (1974) are reproduced in Figures 3.1.5.1.2-6 through 3.1.5.1.2-9. Arrowheads indicate direction of transport, and dots indicate one day's travel, with every fifth day circled. Thus, a hypothetical spill of oil during any season at any point on the chart is estimated to move in the direction of the lines of drift at a rate commensurate with the indicated one-day travel. The figures contain no information regarding the lifetime of a slick, except that the lifetime of slicks originating near the coast may be terminatedin a relatively few days if the slick moves ashore.

As stated earlier, both models do not consider the biological, physical, and chemical weathering of the crude oil. These processes are important in considering the slick life of the spilled oil. Estimates vary. Jeffrey (1973) experimentally spilled 120 tons (800 barrels) of Iranian light crude oil on the sea surface. After four days he reported that most of the oil had disappeared and only patches of rapidly disappearing oil remained. Waldman, Johnson, and Smith (1973) report a seven-day lifetime for the 4,000-barrel spill from a naval ship in the Southern California Bight on 20 August 1971. Hoult (1972) also implies that, with the exception of the Torrey Canyon spill of 80,000 barrels of crude, there is no data available for slicks older than one week. Another exception to Hoult's implications is the Arrow spill in Nova Scotia in February, 1970. In this case, Bunker C fuel oil spilled into seawater at 30.2° F. (-1° C.) had a slick life greater than one month (Waldman et al., 1973).

Spills in the northeast Pacific are expected to deteriorate before reaching land, since the proposed tanker route is 250 to 300 miles offshore. North of Cape Mendocino (northern California, Figure 3.1.5.1.2-10), the tanker route is farther than 80 miles from shore. Wind and current data suggest that oil spilled in this area would not move ashore. From San Francisco to Point Conception, the tanker route is still 20 to 50 miles from shore. Drift bottle studies (Schwartslase, 1963) and wind data again suggest that most spills may not reach shore. However, during the oceanic season (July

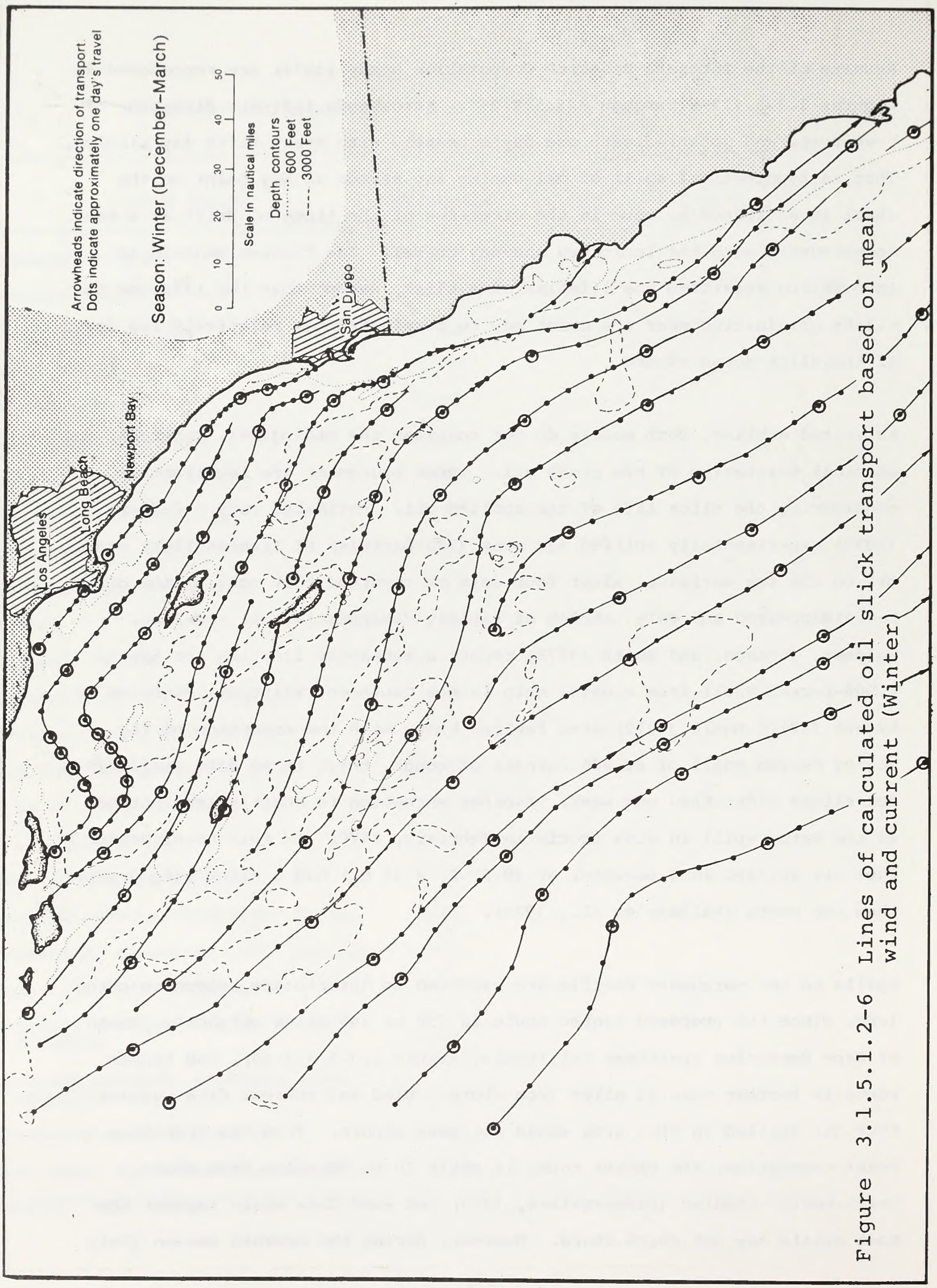

Arrowheads indicate direction of transport.
Dots indicate approximately one day's travel
Season: Winter (December–March)
Scale in nautical miles
0 10 20 30 40 50
Depth contours
600 Feet
3000 Feet
Los Angeles
Long Beach
Newport Bay
San Diego

Figure 3.1.5.1.2-6 Lines of calculated oil slick transport based on mean wind and current (Winter)

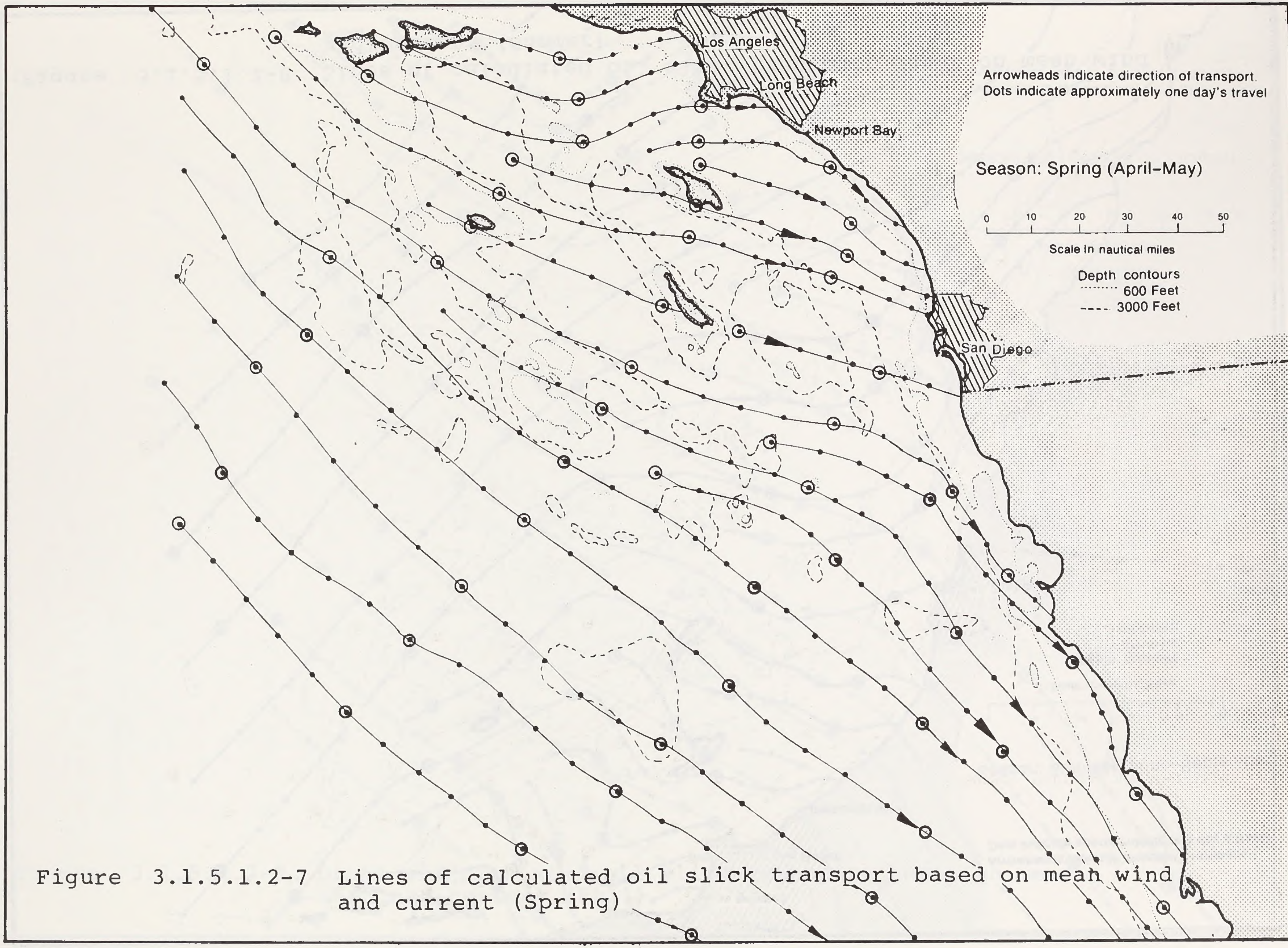

Los Angeles
Long Beach
Newport Bay
San Diego
Arrowheads indicate direction of transport.
Dots indicate approximately one day's travel
Season: Spring (April–May)
0
10
20
30
40
50
Scale in nautical miles
Depth contours
600 Feet
3000 Feet

Figure 3.1.5.1.2-7 Lines of calculated oil slick transport based on mean wind and current (Spring)

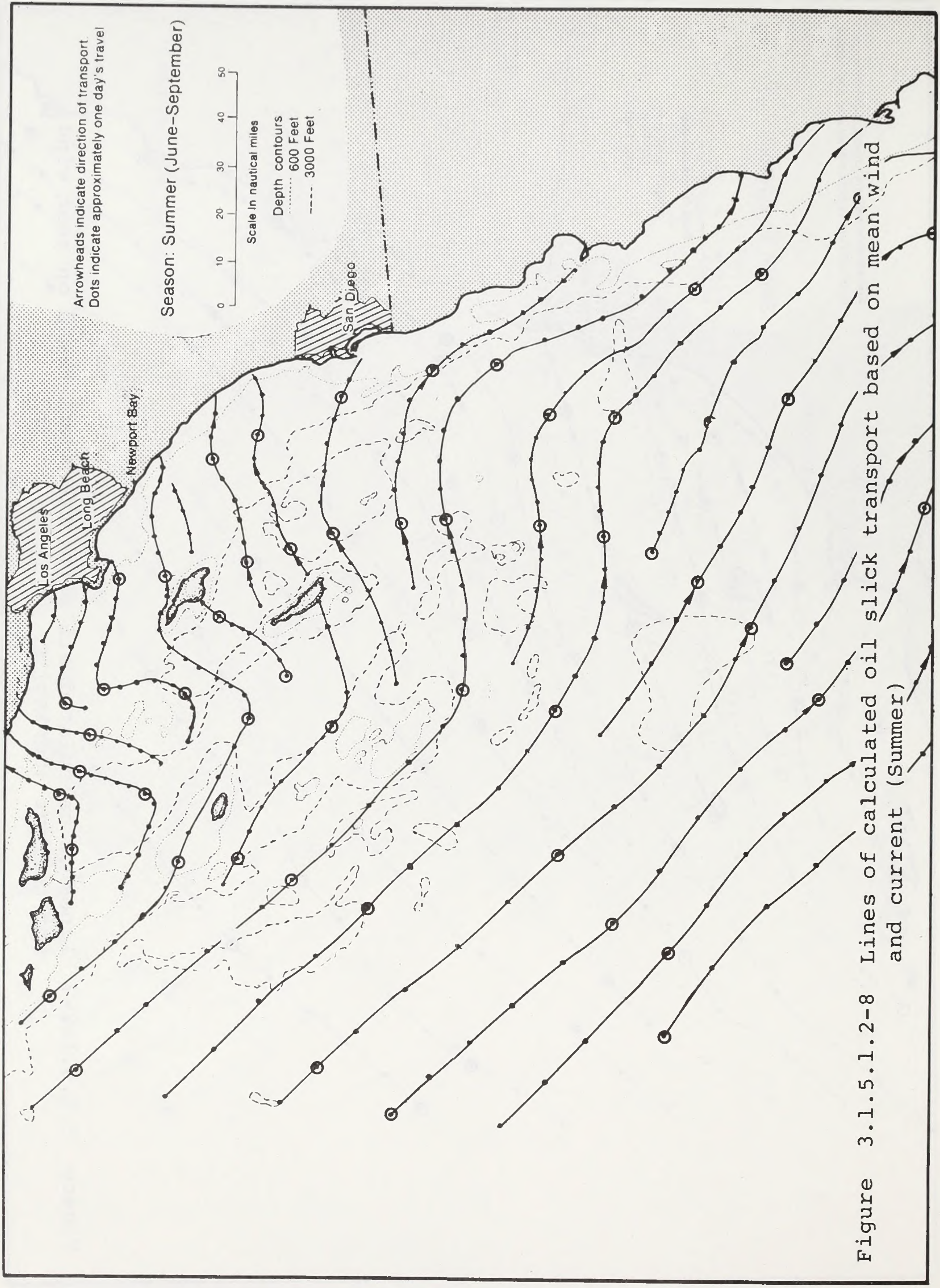

Arrowheads indicate direction of transport
Dots indicate approximately one day's travel
Season: Summer (June–September)
0
10
20
30
40
50
Scale in nautical miles
Depth contours
600 Feet
3000 Feet
Los Angeles
Long Beach
Newport Bay
San Diego

Figure 3.1.5.1.2-8 Lines of calculated oil slick transport based on mean wind and current (Summer)

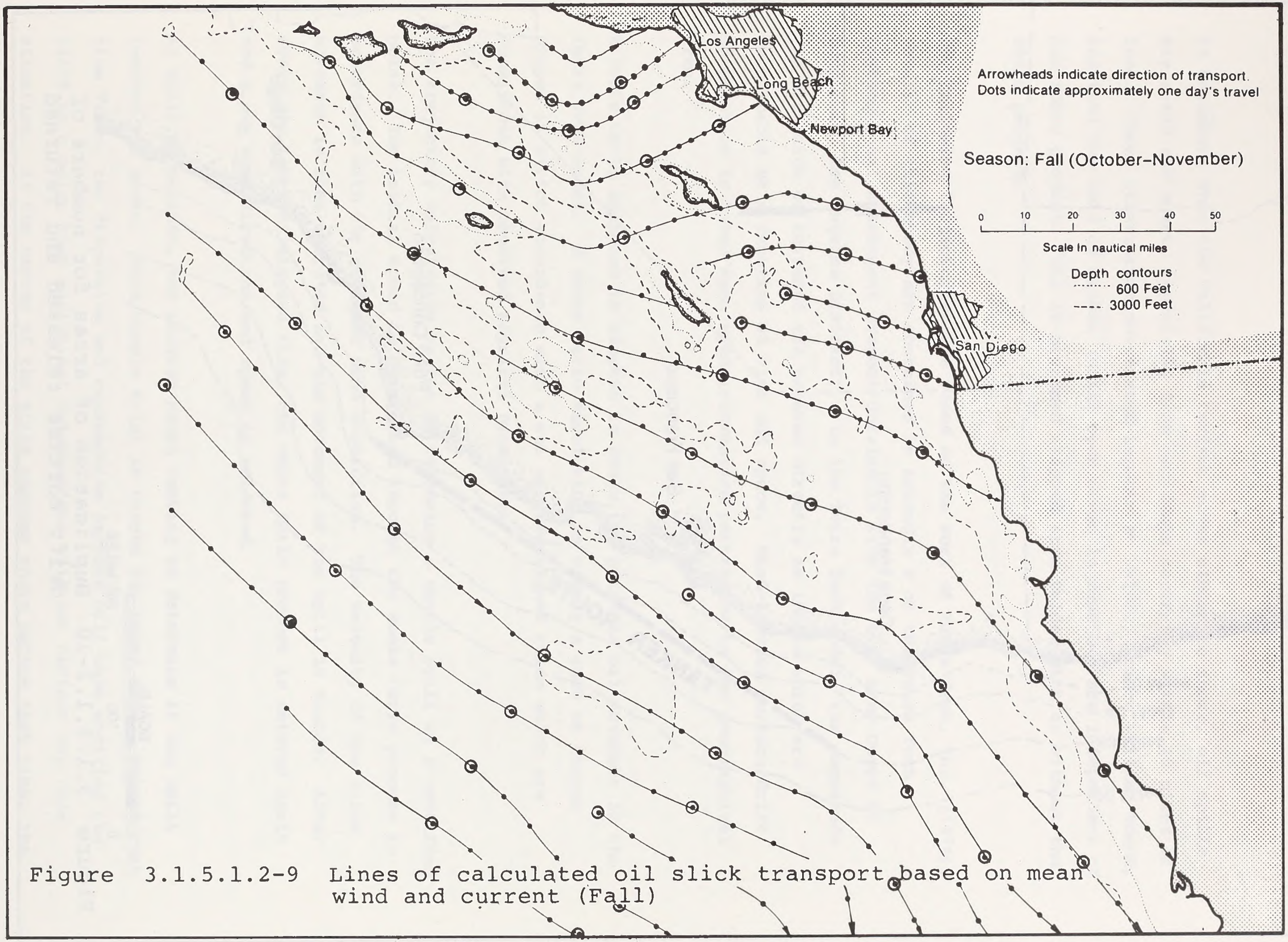

Los Angeles
Long Beach
Newport Bay
San Diego
Arrowheads indicate direction of transport.
Dots indicate approximately one day's travel
Season: Fall (October–November)
0
10
20
30
40
50
Scale in nautical miles
Depth contours
600 Feet
3000 Feet

Figure 3.1.5.1.2-9 Lines of calculated oil slick transport based on mean wind and current (Fall)

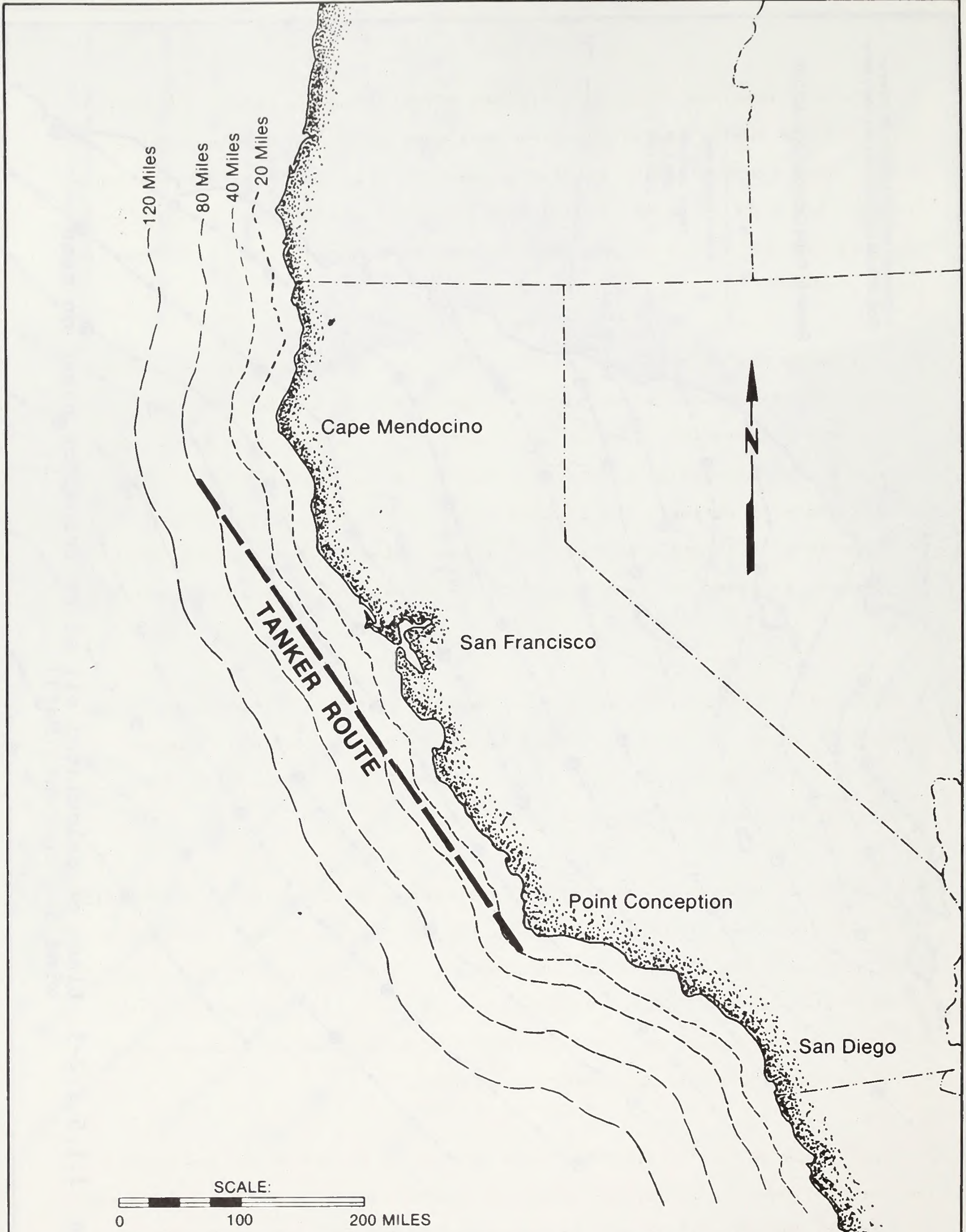


Figure 3.1.5.1.2-10 Duplication of areas for numbers of drift bottles released and returned

to November) when the California Current moves closer to shore, oil spills may reach the coast, especially from accidents occurring within 20 miles of land. These transportation-related impacts at Valdez, Prince William Sound, and into the Gulf of Alaska (until open ocean is reached) are independent of the SOHIO project. Oil is presumed shipped from Valdez with or without the SOHIO project.

The following trajectories are based on the work of Tetra Tech, Inc. (1976). Details of this study are contained in Appendix B of the Tetra Tech Environmental Assessment (report obtainable from the U.S. Army Corps of Engineers, Los Angeles District). In the Tetra Tech model, the magnitude and direction of currents are treated directly as inputs which are describable as a function of time and space. Wind-induced surface drift computation is based upon wind information pertaining to the geographical area.

A Monte Carlo approach is adopted to trace the probable oil movement in the Tetra Tech model. A Monte Carlo simulation is simply a game of chance played in strict accordance with a set of preassigned rules which are consistent with observed physical processes.

The trajectory calculation begins by releasing a sample spill at a specified point. The initial speed is determined through the Monte Carlo process in accordance with the assigned wind statistics. The velocity of the slick movement is then computed and the movement of the spill is traced. After every six hours of elapsed time, the Monte Carlo process is entered again and a new wind direction and speed is selected.

As spill propagates, the program keeps testing to determine if the spill reaches the shore. Each sample trial is traced for three days. Beyond that time frame, the dispersive and consumptive factors will have modified the slick to a point that analytical calculations will not reflect the true situation. If the center of the slick reaches shore before that time, the trial is stopped and a new one begun. The process is repeated 100 times for each season at each release point (for some cases, 200 trials were run).

Seventeen locations along the most direct route between Valdez, Alaska, and Long Beach, California, were selected for oil spill analysis. The selections were based on potential spill locations that could threaten important biological, recreational, or commercial resources.

Based on historical data, the average volume of oil spilled in tanker accidents by ships in the size classes of the SOHIO fleet is approximately 48,000 barrels per spill. This value was used in the trajectory calculations. Wind information for each spill location was obtained from the wind statistics, given in Attachment 2.

A large release of oil inside Valdez Arm would reach shore within 24 hours. Twenty miles or more of shoreline could have stranded oil. The prevailing winds are such that the oil would be more likely to strand on the western shoreline (60 to 70 percent chance) than on the easter shoreline (40 percent chance). There is no marked seasonal difference. It is likely that the slick would be spread throughout the water surface in the Arm. Large oil spills would contaminate Sawmill Bay, Jack Bay, Galena Bay, and Tatitlek Narrows. If 10 percent of the crude oil cargo were lost from the largest SOHIO tanker and 10 percent of that is soluble, the concentration of hydrocarbons in the upper 2 meters could be 4.5 ppm or higher, a very significant reduction of water quality for this area.

Very little is known regarding wave heights in Valdez Arm; so the effectiveness of containment and cleanup procedures to reduce the degradation of water quality cannot be estimated.

Because of winds and currents, oil released at the entrance to Valdez Arm will tend to move in a northerly direction. There is a 40 percent probability that within 72 hours oil will strand on Glacier Island. Other areas that can be affected include both shorelines of Valdez Arm, Galena Bay, Columbia Bay, and Bligh Island. In general, depending on the volume spilled, an oil slick can be expected to cover most of the waters of these areas and pollute 40 or more miles of shoreline. Concentrations for a 120,000-barrel oil spill could reach 0.7 ppm (neglecting evaporation) in the top 6.6 feet (2 meters). This is approximately 35 times present concentrations in Prince William Sound and about 7 times greater than that found in waters off Santa Monica, california.

A spill at the Hinchinbrook entrance would have about a 55 percent chance of stranding on either shoreline of the entrance. There is about a 15 percent chance that the oil would reach Seal Rocks. Depending on the volume of oil that is released, 50 or more miles of coastline and a number of bays could be affected. Included are Orca Bay, Port Gravina, Port Etches, Zaikof Bay, and Rocky Bay. Although water quality would be degraded significantly, the fact that the area is open to the sea should provide good flushing, and reductions in concentrations of hydrocarbons should occur at a more rapid rate than at points farther into Prince William Sound.

If a tanker should ground on Wessels Reef or be damaged by other causes, any oil released would coat the above-water rocks. The prevailing winds generally blow from the southerly quadrant and it is likely that oil would be transported away from Middleton Island toward Cape Hinchinbrook. It would not reach shorelines within the 72-hour time frame. There is, however, a small chance (less than 2 percent) that the oil slick could move southerly and strand on Middleton Island. It is generally agreed that a large portion of the original volume of oil will evaporate in the first few days (DOI, 1976). Tests on crude oil slightly heavier than Prudhoe Bay crude oil indicated that approximately 50 percent of the original volume would be lost to the atmosphere by evaporation within the first four days. This factor, in conjunction with the natural mixing in ocean waters, should ensure that the degradation of water quality should be of short duration.

Water-circulation patterns within the Santa Barbara Channel are complex and meander from season to season. As a result, it is difficult to predict with accuracy the exact locations where oil spills would strand. Selecting locations based on circulation patterns, it was found that the likelihood of oil reaching shorelines and coastal bodies of water was high. Stated differently, if a large oil spill occurs in the Santa Barbara Channel, there is a high probability that coastal sites will be impacted. The degree of impact will vary depending on the location of the spill. Those that occur offshore of Santa Barbara have a 40 to 50 percent chance of moving onto Santa Barbara beaches. Those that occur off Port Hueneme have less than a 20 percent chance of stranding within 72 hours. Those that occur in Santa Monica Bay may not impact shorelines.

Oil can also reach the islands of San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Catalina. The likelihood of this occurrence depends on the location of the spill. Spills that occurred at one location had a 30 to 50 percent chance of reaching Santa Cruz Island and a 10 to 30 percent chance of reaching Anacapa Island.

The length of shoreline that would be polluted depends on the location of the spill and the local winds and currents. In the 1969 Santa Barbara oil spill, more than 100 miles of shoreline was affected. However, this spill involved the continuous discharge of oil for about four months; so that as winds and currents changed there was fresh oil available that could drift toward new locations.

Massive oil spills will cause serious short-term, localized degradation of water quality within the Santa Barbara Channel. Information is not available to assess the length of time that hydrocarbon levels would remain above tolerance levels of sensitive species.

Wave action in the Santa Barbara Channel is generally slight. The deployment of oil containment devices and effective use of oil cleanup equipment at the spill location is possible. The degree to which this may reduce the threat posed by an accidental oil spill cannot be determined. Oil cooperatives maintaining suitable equipment are located at Santa Barbara and at Long Beach.

Water quality. Tanker discharges and oil spills, operational and accidental, would be the major causes of water quality degradation related to the proposed tanker route. Depending on the air, oil, and water temperatures and the wind conditions, a conservative prediction is that 20 to 40 percent of the spilled oil would evaporate during the first three weeks of the spill (based on specific properties of the North Slope crude and southern California meteorological conditions). The remainder would act as a source of pollution and would be dissolving, forming emulsions, undergoing photochemical oxidation, forming tar lumps, and incorporating into the sediments. The effects would include depletion of dissolved oxygen concentrations by oxidation of chemical or biological products, an increase in the level of dissolved hydrocarbons and trace metals in the surface and near-surface waters, and contamination of the deeper and bottom waters by any oil carried down by particulate matter and incorporated into the sediments.

A factor contributing to the impact on water quality is the existing water quality. Most of the areas along the tanker route are relatively pristine. Relative to coastal areas of low water quality, these areas have a large capacity to absorb spill pollutants before they reach lethal concentrations. However, large changes in water quality could have a catastrophic impact on the local biota. Harbor areas of already high toxic loads could reach maximum acceptable toxic concentrations, resulting in lethal dose levels. Overall, potential oil spills could result in significant water quality deterioration.

Port of Long Beach area

The Waterways Experiment Station, Vicksburg, Mississippi, performed numerical model tests of tidal circulation for master plan Pier J configurations for the SOHIO project (Raney, 1976). The following impacts on tidal circulation reflect model tests of the SOHIO project which were conducted concurrently with an assumed 10-acre landfill south of Pier J and a 600-foot opening between the landfill and the SOHIO breakwater. There are no plans to test the SOHIO proposal without the separate 110-acre fill project, but the impacts of the SOHIO proposal should definitely be less than those tested. Range locations are shown on Figure 2.1.5.1.3-1.

Tidal heights. The tidal heights in the harbors were not changed by the Pier J modifications.

Tidal currents. The tidal velocities throughout the Los Angeles-Long Beach harbors changed only slightly, primarily near maximum flood and ebb conditions. The following observations are based on analysis of the volumetric flow rates across the velocity ranges:

1. There is an increase of approximately 12 percent in the maximum flow rate across Range 1.

2. There is about a 6 percent decrease in the maximum flow rate across Range 2.

3. There is very little change in the flow rate across Range 3.

4. There is a 10 percent reduction in maximum flow rates across Range 5.

5. There is very little change in maximum flow rates produced at Range 8 although there appears to be a slight change in phase of the maximum flow rate.

Circulation patterns. The Pier J modification appears to result in only minor overall changes to the tidal circulation in the Los Angeles-Long Beach harbor complex. The primary circulation changes appear to be local in nature. Specific conclusions concerning the changes in tidal circulation produced by Pier J modification are as follows:

1. There is a slight increase in flow through the Angels Gate opening. This is most pronounced during the maximum ebb condition when it amounts to an increase of approximately 0.25 foot per second (fps).

2. There is a slight decrease in flow (approximately 0.1 fps) through the Queens Gate opening.

3. There appears to be very little effect on flow in Cerritos Channel. The net westward flow in Cerritos Channel appears to be retained, although decreased very slightly.

4. There appears to be little effect northeast of the Queens Gate opening except in the immediate vicinity of the actual modifications where there is an increased southern flow. This maximum increase is during the maximum flood tide and amounts to approximately 0.5 fps.

5. The modifications produce a change in the surface current patterns northwest of the Queens Gate opening. This change primarily shows an alteration in the location of flow rather than an alteration in the volume. The change is an increase in flow that causes a clockwise gyre starting northwest of the modification

and ending west of it. The maximum increase of this flow occurs during the maximum flood condition and amounts to approximately 0.75 fps in the immediate project area.

6. The modifications did not produce any changes in current along the shoreline fronting the cities of Long Beach and Seal Beach. Since no change in currents occurred, there would be no change in the littoral movement (due to changes in circulation) caused by the proposed modifications.

Harbor oscillation. The resonant peaks of the normalized maximum current velocity and the wave height amplification factor do not appear to preclude safe berthing at the terminal areas, given proper mooring practices and adequate mooring equipment.

The incident wave spectrum and ship response versus wave period curves must be known, in addition to the harbor response curves, to determine definitively whether or not ship surge problems resulting from harbor resonance will occur in the berthing area.

Until detailed information on moored ship response as a function of incident wave amplitude and frequency is obtained, definitive conclusions on the precise amount of ship motion cannot be made. However, the oscillations of the berthing area are significantly smaller than typical oscillations noted throughout the Los Angeles-Long Beach harbor complex in the numerical study performed for the entire harbor complex.

Year 2000. Cumulative impacts on tidal currents and circulation in the port area would be slight. Present trends for further development of the harbor, such as the Port of Long Beach general plan with its proposal for landfills and other physical changes, would result in additional significant impacts on water circulation and water quality in the harbor.

Reduced tidal circulation and flushing in the harbor would cause irreversible changes. New landforms would eliminate a large gyre in outer Long Beach Harbor, which would have serious environmental consequences for both Los Angeles and Long Beach harbors. A reduction of the tidal prism (volume passing in and out over a tidal cycle) can have serious impacts on the marine environment. Reducing the tidal prism reduces the tidal movements; consequently, critical velocities governing erosion and sediment deposition can be altered. If the energy patterns are altered, present areas of erosion could possibly become areas of deposition, and present areas of deposition could possibly become areas of erosion. In general, any change in current patterns should be considered an objectionable condition.

The associated reduction in circulation caused by additional landfill would degrade water quality in the inner harbor areas, probably, on many occasions, to a quality below regulatory standards. Water quality in outer Long Beach Harbor would tend to approach present water quality conditions in inner Long Beach Harbor. Decreased circulation could cause nuisance effects, such as pockets where water collects debris and interferes with recreational and some industrial use of the water.

Other possible impacts include changes in nutrient recycling paths, altered salinity levels (a result of the increased surface runoff area), and effects on maintenance of the open channels.

Dredging operations would increase turbidity, but the degree of turbidity would depend upon concurrent projects and their construction periods. Long-term turbidity problems at the disposal site could result from resuspension of fine-grained materials and the erosive forces attacking the new landforms.

3.1.5.2 Pipeline route (including Port land area)

3.1.5.2.1 Conversion/construction

Construction of the proposed pipeline is expected to cause no irreversible changes in the availability, use, or quality of water resources. Because of the short-term earthwork construction period and relatively small linear and areal extent of surface disturbance, most impacts on watersheds and groundwaters would be negligible. Discharge of contaminated hydrostatic test waters at river crossings and construction in riverbeds present the greatest hazards.

Surface water

The ephemeral channels listed in the tables of Appendix A2.1.5.2-2 have a history of high suspended sediment loads during occasional, short periods of runoff. Additions to the load resulting from pipeline construction would be virtually undetectable on the overland route.

Where the route intersects earth-lined irrigation ditches on or adjacent to croplands, flows may be halted during the short time required to excavate and install the pipe. Compaction of reconstructed ditches would minimize soil movement during subsequent irrigations.

Larger concrete-lined canals would be crossed underground by boring horizontally, thereby eliminating impact on the water.

In-stream construction activities at the Colorado River crossing can be expected to produce significant, although temporary, water quality impacts. Assuming that the river flow must be maintained during the construction period to satisfy domestic, irrigation, municipal, and wildlife requirements, excavation and replacement of a minimum of 34,000 cubic yards of river bottom sediments would increase turbidity for some distance downstream. At existing velocities of 1 to 5 miles per hour (Blinn, et al., 1976), it can be assumed that all unconfined excavated material up to 1 inch in diameter would move downstream (Bennett, 1939). Water quality standards of both Arizona and California would be exceeded during this period and there may be short-term reduction of dissolved oxygen (DO) and increased biological oxygen demand (BOD). (See water quality standards in Section 2.2.5.)

At the Pecos River crossing, streambank and riverbed excavation for pipeline support structures and heavy equipment used in installing the pipeline can be expected to increase sediment and turbidity levels temporarily. Impacts would be on riparian plant associations and aquatic biota and are discussed in Sections 3.1.7 and 3.1.8. Deposition of sediment, except that colloidal portion remaining in suspension, would be in the Red Bluff Reservoir below. Detail as to the amount of riverbed soils to be excavated was not provided by the applicant.

Groundwater

Limited impacts upon groundwater resources would result from the use of groundwater from wells adjacent to the route for dust abatement on temporary access roads, personnel uses, concrete mix, and for other minor construction purposes. Expected quantities of water to be used for such purposes would be less than 200 acre-feet (Williams Brothers, 1976). These amounts would be derived locally as needed and available.

Groundwater would be affected by the proposed pipeline if trenching activities intercept the capillary fringe of the water table. Along the proposed pipeline route, water levels are high in the Los Angeles River channel, Rio Hondo, Chino area, and near Pomona and Blythe areas where the water table may rise to within 10 feet of the surface. Some groundwater may be expected to seep into the trench during construction of portions of those segments of the pipeline. The displaced groundwater would be pumped into the adjacent drainages where it would recharge, or be mixed with other waste waters without change in quality. Groundwater quality would not be affected during construction of the overhead pipeline at the Pecos River even though the water table may be relatively high; i.e., within 10 feet of the surface.

Hydrostatic test water. No impacts to groundwater or surface waters are expected from the hydrostatic testing of pipeline based on the proposed water source and disposal points and the water testing and treatment procedures discussed in Section 1.2.3.2, Actions following construction. However, accidental or intentional disposal of test water without proper treatment could be expected to result in violations of state water discharge standards.

In some cases, such as at Midland, indiscriminate disposal of untreated water could result in groundwater contamination. The Midessa-Arvana-Amarillo soil-series association is moderately permeable and the local water table lies at 32 to 98 feet below the surface. If the soil profile above the water table for the total depth is consistent as to texture and permeability, ponding of released water to a sustained depth greater than 4 feet would result in percolation to the 32-foot groundwater table with deleterious impact on the quality, at least in odor and taste of domestic supplies. The efficiency of these soils in reducing the chief contaminants (iron, chemical oxygen demand, and phenols) by filtration is not known (Barkley, 1973 and Ineson, Packham, no date). Various treatment procedures are provided by Dr. William Barkley in his report.

3.1.5.2.2 Operation

As with soil contamination, the major effects on surface or groundwater quality and use during operation of the system would result from pipeline rupture or undetected oil leaks. Causes would be identifiable with either natural phenomena or faults in the system. Locations of areas most sensitive to these occurrences are identified on Maps 2.1.5-1 through -12, Attachment 1.

Probability of oil spills and leaks

Statistical data indicate that the probability of a pipeline rupture and large spill is small. Under large natural forces, pipelines tend to bend without breaking. Federal data for 1974 show that 220,000 miles of pipeline, of all types and age, experienced an average loss of 1.33 barrels per mile of line per year in transporting over 9 billion barrels of petroleum products (DOT, 1974). By comparing initial throughput of the applicant's proposal with these statistics, up to 6,000 bbl/yr could be lost; comparing mileage, about 1,400 bbl/yr could be lost. A figure in between is the most reasonable. If national statistics apply, the average spill size would be in the range of 800 to 1,500 barrels. However, in view of the very small size of most spills, an average figure is of little significance.

Pipeline spills can be placed into three categories:

1. Those too small for detection by the proposed metered monitoring systems.

2. Those that are large enough for detection by the systems (from leakage rather than rupture).

3. Those that follow from rupture of the pipeline.

There should be a certain degree of overlap in sizes of spills from these categories; however, until data from the spill contingency plan are forthcoming, only a rough estimate is possible. Based on available data (Williams Brothers, 1976), it is assumed that:

1. The leaks too small for detection by the monitoring system would release oil indefinitely and could only be detected by degradation of groundwater.

2. The larger spills from leakage are assumed to range between 500 and 3,000 barrels.

3. The spills resulting from ruptures are assumed to exceed 3,000 barrels.

Since there are many causes of spills, national statistical data should be reasonably representative of the frequency of spills in each category. Accordingly, about 5 percent of the spills would be detected by the monitoring system (MIT, 1974), and only about 0.1 percent of the spills would be major ones owing to rupture. Over the life of the project, a maximum of one-fourth of the oil spills would result from rupture, and more than one-half of all oil spilled would result from leaks that are detectable by the monitoring system. Table 3.1.5.2.2-1 indicates the expected number of spills and quantities of oil spilled by type.

Table 3.1.5.2.2-1

Approximate Predicted Pipeline Statistics (Over 10-Year Period)

EVENT	Number of spills	Size of Spill (bbl)	Total Volume of Oil Spilled Percent	 Barrels
Leaks below detection system threshold	400 (max)	Indefinite	<25	9,000 (max)
Leaks above detection system threshold	4 to 20	500 to 3,000	>50	7,000 to 20,000
Ruptures	1 (max)	3,000 plus	<25	9,000 (max)

Source: MIT, 1974.

Limited local evidence suggests that the number of ruptures indicated in the table is perhaps excessive for pipelines of this size and in actuality would not conform to nationwide averages. However, examples are provided in this chapter at specific locations to analyze the potential impacts on surface water and groundwater should ruptures occur.

Surface water

Minor effects resulting from operation and maintenance are associated with equipment use and sediment yields from disturbed surfaces. The primary source would be the permanently maintained patrol road adjacent to the pipeline which would provide sediment plumes in the water during occasional runoff events.

Table 3.1.5.2.2-2 illustrates the maximum potential oil spills at sensitive areas as provided by Williams Brothers Engineering Company. Spill volume is the total volume of oil contained in the pipeline between the closest valve on either side of the location, including the amount of oil lost during remote-valve closure time.

Table 3.1.5.2.2-2

Potential Maximum Oil Spills at Sensitive Locations

LOCATION	Volume (bbl)
Santa Ana River	9,930
Whitewater River	13,428
Colorado River	5,417
Gila River	139
San Pedro River	4,260
Rio Grande	1,805
Pecos River	8,103
San Andreas fault system	9,261

Source: Williams Brothers Engineering Company, 1976 (answers to questions).

The following discussion relates the fate of spilled oil at each of the above locations to the surface water and groundwater at each site.

Santa Ana River. The distribution of oil from a major spill owing to rupture of the pipeline at the Santa Ana River depends on existing conditions, such as a dry riverbed or at flood stage. The maximum potential spill is given by Williams Brothers Engineering Company as 9,930 barrels.

For most of the year the riverbed is dry, responding only after infrequent summer thundershowers or during prolonged winter rainfall. On the basis of the equation given by Davis et al. (1972), and assuming that the porosity is 30 percent and the residual saturation is 0.20, the cubic yards of soil required to attain immobile saturation is $\frac{0.20 \times 9{,}930}{.30 \times .20}$ or 33,100 cubic yards (893,700 cubic feet). Because of the low gradient and relatively shallow depth to groundwater (60 feet) in the very porous stream bed, contact with groundwater is possible. Recovery by pumping as depicted in the Oil Spill Contingency Plan would be necessary to prevent long-term contamination of well waters used for irrigation, industrial, and domestic supplies.

During low flows, oil would migrate downstream for longer distances but would perhaps attain immobile saturation because of the greater distance traveled. Oil spill contingency plan measures would be needed to prevent subsequent runoff from carrying oil downward through the soil to the water table or across the surface to the ocean waters and beaches.

During flood flows, oil would remain on the surface of the water where some would evaporate, some would cling to vegetation and stream banks farther downstream, and the remainder would be carried to the ocean and beaches. Oil spill contingency plan measures for lands, streams, and bays would be needed for cleanup.

Whitewater River. The distribution of oil from a major spill resulting from rupture of the pipeline at the Whitewater River crossing, if unchecked, would not reach the groundwater, which is at a depth of 300 feet. The Whitewater River is a desert wash and flows only after infrequent heavy rains. The maximum potential spill volume at this crossing is given by Williams Brothers Engineering Company as 13,428 barrels.

The amount of soil required to attain immobile saturation for that volume of oil is $\frac{0.20 \times 13{,}428}{0.30 \times 0.20}$ or 44,760 cubic yards (1.2 million cubic feet), assuming a porosity of 30 percent and a residual oil saturation of 0.20.

Oil spill contingency plan measures for cleanup of spills on soil would be required to ensure that oil would not be carried deeper or farther by subsequent runoff to contaminate groundwater or endanger streamside values.

Colorado River. The distribution of oil from a major oil spill resulting from rupture of the pipeline at the Colorado River would be governed primarily by the velocity of the river. The oil would rise to the surface of the water, tend to spread on the surface, and then flow downstream with the current. Some of the oil would evaporate and some would diffuse in the water.

The velocity of the Colorado River ranges from about 1 to 5 miles per hour, depending on the discharge. Assuming that the oil slick travels with the above velocities, the oil front, if unchecked, would reach the Cibola National Wildlife Refuge in 7 to 20 hours and Imperial Dam in 23 to 70 hours.

The Colorado River, even where contained by levees, meanders from one side of the channel to the other, and oil floating on the water would come in contact with the banks. Because of the low hydraulic gradients, the viscous nature of the oil, and the short time in which the oil would be in contact with the bank, little penetration by the oil into the banks would be expected. If the rupture were to occur during a time when the stage was increasing, the effect of bank storage would be greater. Conversely, if the break occurred during a falling stage, groundwater in bank storage would be draining to the river, and the possible penetration of oil into the bank would be minimized.

If a spill on the Colorado River were not checked, the oil slick would eventually pond behind Imperial Dam.

The Colorado River is continuously moving sediment downstream, and numerous sandbars are present. Where the these occur, the depth to water is shallow, and in periods of low flow, the sandbars are exposed. Thus, there is some opportunity for oil to mix with suspended sediment, sand or detritus, contribute oil to bottom sediments, and enter groundwater aquifers.

Water for domestic use which contains oil is objectionable and unpalatable at far below the chronic toxicity levels of the various oil components. Taste is the most sensitive method for detection of oil, and according to Davis et al. (1972), concentrations of oil as low as 0.1 ppm can be tasted.

Assuming that the bulk of cleanup effort would be at Imperial Dam, diversions at this point for agricultural and urban uses would necessarily be suspended. The assumption is also made that diversions between the break and Imperial Dam would be closed for at least the 23- to 70-hour period of the passing of the main flow of oil.

Gila River. The pipeline crosses the Gila River about 1,000 feet downstream from Gillespie Dam, which is a diversion structure for irrigation. Not all water is diverted and the amount that continued downstream in 1974 ranged from 2.9 to 57 cfs (USGS, 1974). This flow gradually disappears into the alluvium of the Gila River. Occasionally, large floods pass over Gillespie Dam and continue downstream to Painted Rock Reservoir.

The maximum amount of oil that may spill at the Gila River crossing as a result of rupture is 139 barrels (Williams Brothers, 30 July 1976).

Some flow below Gillespie Dam is present throughout the year and the velocities of these flows are usually less than 1.5 feet per second.

If not checked, some oil would flow with the current and would be deposited on the sides of the channel as bank storage. The remaining flow would be deposited on the surface sediments in the dry riverbed. Use of diverted water for irrigation, chiefly cotton and alfalfa, would be suspended pending cleanup.

During a major flood, such as that of 1966 when a discharge of 45,000 cfs and a mean velocity of 4.5 fps were measured, the conditions could be radically different. Since the distance from Gillespie Dam to Painted Rock Dam is about 40 miles, the oil from a major break would reach Painted Rock Dam in nine hours or less, if unchecked.

A flood of this magnitude spreads over the floodplain with the main channels having higher velocities than the rest of the channel because of brush and trees that impede the flow. The oil would adhere to banks of the stream and to trees and brush in the channels. Much oil would tend to float. However, oil would also tend to adhere to suspended sediment because of the turbulence of such floods and the large amount of suspended sediment. Subsequent low flows and precipitation would tend to carry the oil downward into contact with the shallow water table under the riverbed.

San Pedro River. The distribution of oil from a major oil spill resulting from rupture of the pipeline at the San Pedro River crossing would depend on existing conditions such as a dry riverbed or a flood. The maximum potential spill volume at this crossing is given by Williams Brothers Engineering Company as 4,260 barrels.

When the San Pedro River is not flowing, the depth to groundwater beneath the floodplain ranges from 6 to 40 feet, and groundwater is used for growing crops. It is estimated that under the assumed conditions, the downward flow rate would be about 2 gallons per minute. The downward seepage velocity can be estimated as $\frac{2 \times 60}{23.4 \times 0.3 \times 7.48}$ or 2.3 feet per hour. The depth to which oil would penetrate in the time required for cleanup crews to get to the crossing (estimated as 210 minutes) would be about 5.5 feet. Although approximate, it suggests that some oil might reach the water table if such a spill occurred at the San Pedro River crossing. Most of the oil, however, would flow down the San Pedro River until absorbed by the alluvium and immobilized.

According to Roeske and Werrell (1973), the flow of the San Pedro River usually ceases in the spring or early summer near Redington, and streamflow generally is not sustained for long periods downstream from Redington.

A major oil spill during low flow at Redington would behave in a manner similar to that for the Gila River, described in the preceding pages, and would eventually be exhausted to immobility. However, if flow were sustained for long periods near Redington, the water table would coincide with stream surface and spilled oil would be in contact with the groundwater.

During floods of 4,000 to 12,000 cfs, mean velocities of 10 to 12 fps occur (6.8 to 8.2 mph). Assuming a flood with a mean velocity of 7 mph, an oil front would advance 17.5 miles in the time that it would take to have cleanup crews at the site. The effects of a major oil spill during time of flood would be similar to those described for the Gila River. However, because the water table is shallower beneath the San Pedro River floodplain, there would be more opportunity for the oil to contact the water table.

Rio Grande. The distribution of oil from a major oil spill from rupture of the pipeline at the Rio Grande would be governed by the amount of flow at that time. During the winter months, the flow comes from drains in the irrigated areas, and this may be from less than 10 to as much as 100 cfs, although occasionally the river is dry.

If a rupture occurred, the moving oil would adhere to river banks, to vegetation growing on the banks or in overflow channels, and to rock levees and other man-made structures. Some of the oil would evaporate, and some would diffuse in the water. Suspended sediment in the river would tend to mix with the oil and contribute to bottom sediments.

The estimated cleanup response time at the Rio Grande crossing is 2.5 hours (Williams Brothers, 1976). During this time, the oil would travel about 7 to 10 miles. Diversions of water for irrigation, urban, and industrial uses would be halted until containment and cleanup could be effected. Length of time required would be dependent upon the efficiency of cleanup measures and equipment available.

Pecos River. The distribution from a major oil spill after rupture of the pipeline at the Pecos River crossing would be governed by the discharge at that time.

The discharge of the Pecos River at Red Bluff, about 1.6 miles southwest of the pipeline, has ranged from less than 1 to as much as 111,000 cfs on 23 August 1966 (USGS, 1970). The mean velocity for selected discharges are as follows: 0.45 feet per second for 10.1 cfs; 1.06 for 50.8; 2.67 for 101; 3.25 for 3,640; and 4.21 for 15,000. In miles per hour, these range from 0.33 to about 3.

If a rupture were to occur during low flow, the volume of oil could overwhelm the river flow, and most of the oil would be absorbed by alluvium until exhausted to immobility. Williams Brothers Engineering Company estimates that the maximum potential spill volume at the Pecos River crossing is 8,103 barrels. Using the equation given by Davis et al. (1972), and assuming that the porosity is 30 percent and the residual saturation is 0.20, the cubic yards of soil required to attain immobile saturation is $\frac{0.20 \times 8{,}103}{.30 \times .20}$ or 27,010 cubic yards (729,270 cubic feet).

During higher flows, the oil would tend to float downstream with some oil adhering to banks and vegetation. In the estimated two hours that it would take to get cleanup crews to the rupture, the oil would travel an estimated 2 to 8 miles, eventually ending in the 11,000-acre Red Bluff Reservoir. Impacts are addressed further in Section 3.1.8. Oil Spill Contingency Plan measures for bodies of freshwater would need to be activated.

San Andreas Fault system

A major oil spill due to a rupture at the crossing of the San Andreas Fault system would release 9,261 barrels of oil (Williams Brothers, 1976). If not contained, the oil would flow until exhausted to immobility or until groundwater was reached. The amount of soil required to attain immobile saturation for that volume of oil is $\frac{0.20 \times 9,261}{0.30 \times .20}$ or (833,490 cubic feet).

The depth to water in a well about 3 miles northwest of the crossing is 67 feet. In another well about 4 miles southeast of the crossing, depth is 76 feet. Should the pipeline break because of a 20-foot horizontal displacement in the ground, there is a good chance that vertical fracturing would provide paths for oil to reach the groundwater table. Included in the restoration and rehabilitation activities would be a need for contingency plan measures to remove the oil from urban and agricultural underground supplies.

Groundwater

Small leak. The maximum leak that might go undetected is given by Williams Brothers Engineering Company as about 0.5 percent of the main line flow rate of 500,000 bbl/d, or about 73 gallons per minute.

The quantity of water that flows downward or laterally in soils is given by the equation: $Q = kIA$ (Wenzel, 1942); where Q is the quantity of water in cubic feet per minute, k is the permeability in feet per minute, I is the hydraulic gradient in feet per feet, and A is the cross-sectional area in square feet.

Assuming that $k = 0.2$ foot per minute, $I = 1$ foot/foot, and $A = 23.8$ square feet (circle of 5.5 feet in diameter), then the vertical flow of water is 35.9 gallons per minute and the flow of (0.05 that of water) is about 1.7 gallons per minute.

In addition to the downward flow of fluid from a small leak in a pipeline, there would be flow along the trench. The quantity of water is determined from the same equation $Q = kIA$. In this case, it is assumed that the backfilled trench is 6 feet deep and 5.5 feet wide, that the diameter of the pipe is 3.5 feet, that the permeability of soil for water is 0.2 foot per minute, and that the porosity is 30 percent. Also, two gradients are assumed, 0.05 and 0.3. In actuality, gradients of the trench would vary from zero to more than 0.3. However, these two indicate a possible range: for a gradient of 0.05, seepage of oil along the trench (0.05 that of water) would be at a rate of about 0.1 gallon per minute; for a gradient of 0.3, or 6 times 0.05, the quantity of oil is about 0.5 gallon per minute.

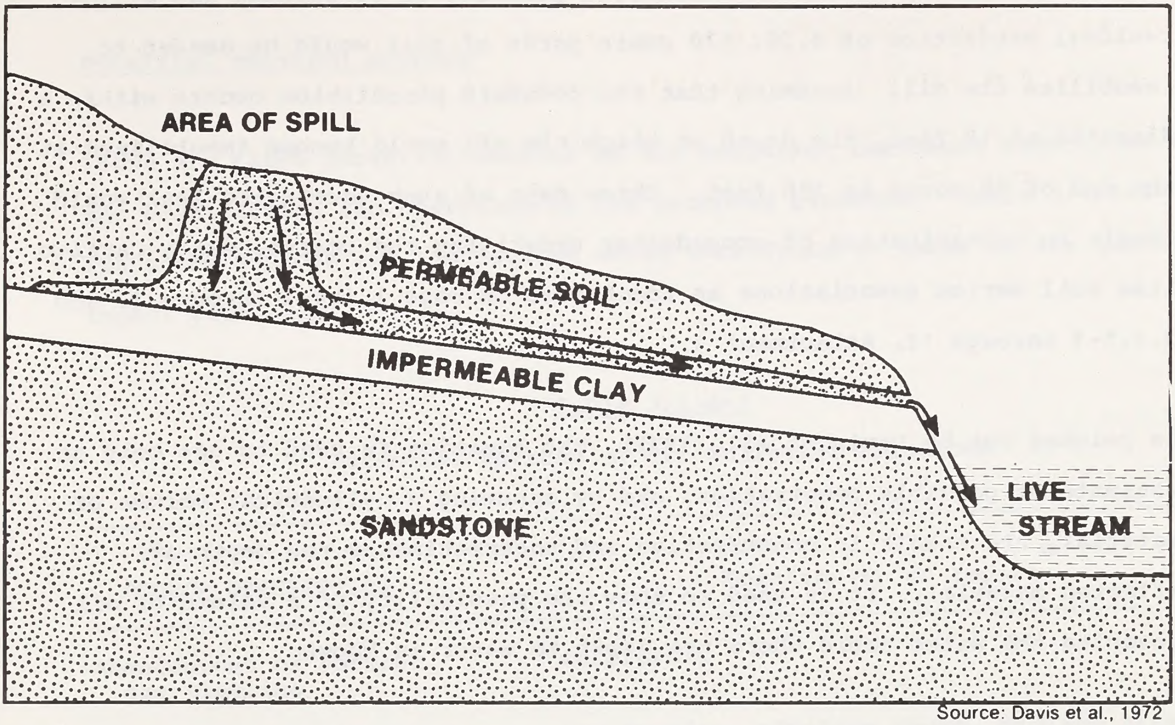
The actual quantity, before detection, under the aforementioned assumptions, would be less because the area is the entire cross section of the trench. The seepage velocity of the oil in the trench, using the above assumptions, is the quantity of oil divided by the cross-sectional area and the porosity.

For quantities of 0.1 and 0.5 gallon per minute, the seepage velocity laterally is 2.7 feet per day and 13.7 feet per day, respectively.

Although the method used to estimate the probable amount of oil that might percolate downward and laterally is approximate, it suggests that small leaks of 2 to 5 gallons per minute could go undetected, and that leaks greater than this would surface and be visible.

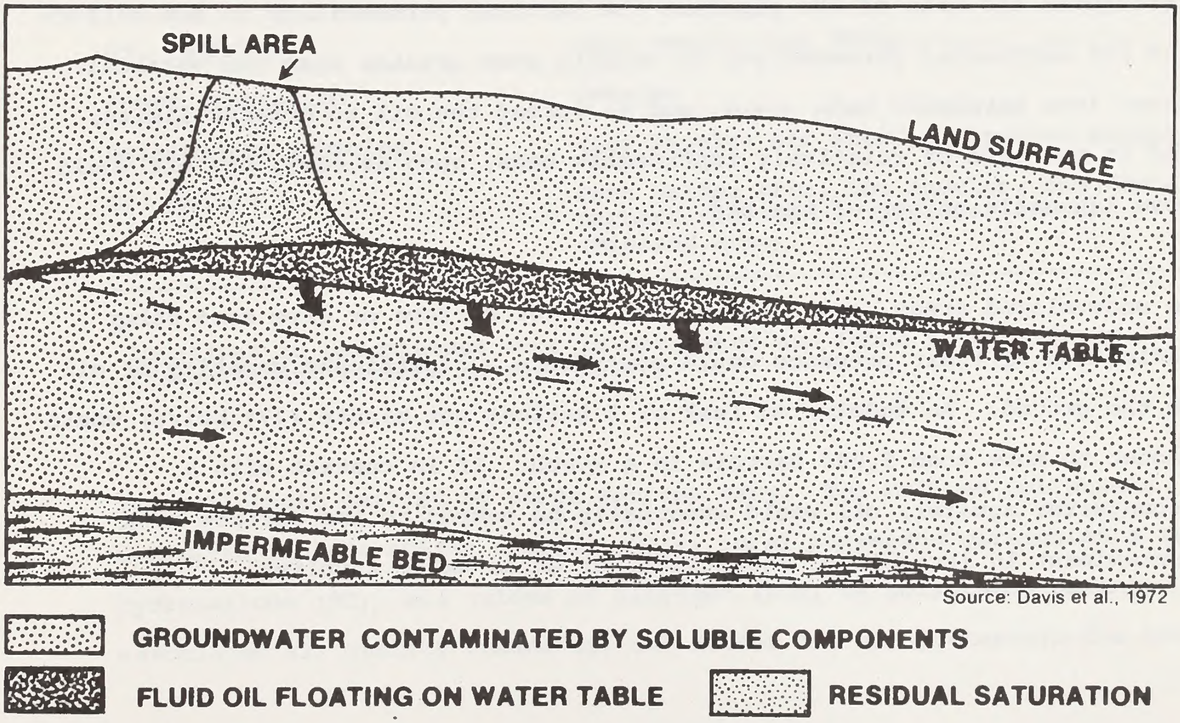
Assuming that an undetected leak of 5 gallons per minute (171 bbl/d) occurred, it is desirable to know if this would reach the water table. In addition to the several assumptions that have been made, it is assumed also that the material is an homogeneous and isotropic medium. A further consideration is that the depth to groundwater along the pipeline ranges from less than 10 feet to more than 500 feet.

Davis et al. (1972) present a simple method for determining the volume of soil required to immobilize a given amount of oil. This is based on the porosity of the material and the maximum residual saturation, which is based on the nature of the hydrocarbon. Figures 3.1.5.2.2-1 and 3.1.5.2.2-2 illustrate oil migration to live stream and oil migration to water table.



Source: Davis et al., 1972

Figure 3.1.5.2.2-1 Oil migration to live stream


SPILL AREA
LAND SURFACE
WATER TABLE
IMPERMEABLE BED
GROUNDWATER CONTAMINATED BY SOLUBLE COMPONENTS
FLUID OIL FLOATING ON WATER TABLE
RESIDUAL SATURATION

Source: Davis et al., 1972

Figure 3.1.5.2.2-2 Oil migration to water table

For the undetected leak of 171 bbl/d, a porosity of 30 percent and a residual saturation of 0.20, 570 cubic yards of soil would be needed to immobilize the oil. Assuming that the downward percolation occurs within a diameter of 10 feet, the depth at which the oil would become immobilized at the end of 24 hours is 196 feet. Three days of such undetected leak would result in contamination of groundwater underlying the coarse, sandy Carrizo like soil series associations as identified on Maps 2.1.4-1 through 12 and 2.1.5-1 through 12, Attachment 1.

As pointed out by Davis et al. (1972), the equation is used to get only an estimate of possible penetration, and by assuming a cylindrical volume of material, the result is conservative and underestimates the depth of affected material. It is used to show the possibility of a volume of oil reaching the water table where the depth to water is known.

This suggests that a small undetected leak could percolate downward nearly 400 feet in two days. Actually, it is not believed that the downward percolation could proceed at such a rate. This is based on the facts that throughout the area of the pipeline the vertical permeability is not uniform and the horizontal permeability is usually much greater than the vertical. These less permeable beds would tend to spread the oil to greater limits, and in the case of relatively impermeable beds, such as clay, the oil would move laterally on top of the bed.

In undeveloped areas, small leaks that do not surface or give some other indication of their presence could contribute a significant quantity of oil to the ground. An undetected leak of 5 gallons per minute (171 bbl/d) would amount to more than 5,000 barrels in a month. If in contact with a groundwater aquifer, oil would eventually be pumped to the surface as a contaminant in irrigation, industrial, or urban water supplies.

3.1.6 Air quality

Potential emission sources

There are eight potential sources of air pollutant emissions associated with the construction and operation of the proposed pipeline. Table 3.1.6-1 lists the sources and the regions which were found to incur an air quality impact from them.

Table 3.1.6-1

Potential Sources of Air Pollutant Emissions

SOURCE DESCRIPTION	Location(s) of Impact[a]
Abandonment of natural gas pipeline	California
Construction equipment	Los Angeles, pipeline route, Midland area
Tanker operations	Valdez, Los Angeles, and Santa Barbara air sheds
Oil storage tanks	Los Angeles Air Shed, (pipeline route), (Midland area)
Oil refining	(Los Angeles Air Shed)
Power generation	Unknown
Maintenance vehicles	(Los Angeles Air Shed), (pipeline route)
Oil spills	Port Valdez area, Los Angeles, and Santa Barbara air sheds, (pipeline route), (Midland area)

[a] Locations in parentheses were investigated and found to experience insignificant impacts on air quality.

The pollutants emitted by these sources vary. The emitted pollutants evaluated include sulfur dioxide (SO_2), total suspended particulates (TSP), hydrocarbons (HC), and oxides of nitrogen (NOx) as pollutants having associated air quality standards; the latter two are precursors for the secondary air pollutant, oxidant which is also subject to state and Federal limits. (There is unavoidable confusion: That which is emitted (primary emissions) is not always that which is measured or considered injurious. Hydrocarbons evaporate. SO_2 and nitric oxide (NO) are principal products of combustion. The sulfur oxides in the exhaust gases continue to oxidize further and the mixture is called SOx. Some of the NO oxidizes further, and the mixture is called NOx. Particulates from combustion and dust get lumped into a grab bag called TSP; oxidant is a grab bag for corrosive chemicals, including ozone, that arise from action of ultraviolet light on chemical mixtures of HC and NOx.) Table 3.1.6-2 shows the primary pollutant emissions associated with the identified sources.

Table 3.1.6-2

Primary Pollutants Emitted

by Project-Related Sources

SOURCE DESCRIPTION	Pollutant Species			
	HC	NOx	SO_2	TSP
Abandonment of natural gas pipeline			X	X
Construction equipment	X	X	X	X
Tanker operations	X	X	X	X
Oil storage tanks	X			
Oil refining	X	X	X	X
Power generation		X	X	X
Maintenance vehicles	X	X	X	X
Oil spills	X			

Natural gas pipeline abandonment. Prior to construction, the proposed project calls for the removal from service of one El Paso natural gas line from the Permian Basin in New Mexico to California; the line would be converted to shipment of surplus West Coast crude oil to the East. The reduced capacity of the natural gas transmission system is expected to result in decreased availability of natural gas to users of the system (decreased capacity necessitates additional pumping power and this in turn, necessitates additional natural gas withdrawals from the line as fuel for the compressors). To compensate for reduced throughput of gas, other more polluting fuels will have to be substituted by gas consumers who can perform the fuel substitution. Ambient levels of sulfur oxides and particulates are expected to increase significantly in the industrial area surrounding the proposed crude oil terminal. Selected industrial areas elsewhere in California would also experience similar, or perhaps smaller, adverse incremental impacts. Analysis of the need and requirements for emission offsets to compensate for this effect is in a preliminary stage (see Section 2.1.6.5). Section 3.1.6.1.2 contains a more detailed analysis.

Tanker operations. Pollutant emissions from tanker operations within the harbor would result primarily from unloading of crude oil while tankers were in berth. Tanker emissions during other portions of a call at the harbor would result from "hoteling" (use of the tanker's engines at approximately 10 percent power to provide on-board electric power at dockside) and passage of the tanker from the harbor entrance to the berth and back with tug assistance. Emissions from hoteling were found to be negligible in comparison to those associated with unloading and hence are only presented in Appendix A3.1.6.1. Unloading of crude oil from the tankers would be accomplished using on-board pumps driven by engines on the tankers. During pumping, the tanker's engines are operated at high power resulting in substantial emissions of NOx and SO_2 as well as some HC and particulate matter (see Tables 3.1.6.1.2-2, -4 and -8).

Crude oil unloading operations and subsequent ballasting on some tankers can also result in hydrocarbon vapor losses from the tanker's cargo tanks. Some tankers have ballast tanks which are also used to carry crude oil (non-segregated ballast). There is a rich mixture of hydrocarbon vapors above the oil with a very high density of vapor in the first 10 feet above the oil; after discharge of the oil, the vapors remain in the tank. If the tank is refilled with ballast water, the vapors in the tank are displaced to the atmosphere with the total amount of emissions depending on how completely the tank was filled (MacKenzie, 1976).

Under normal operating conditions, all tanks are closed to the atmosphere. A buildup of pressure would open a valve and vent hydrocarbon emissions. There are also occasions when it becomes necessary to completely replace the gases in an empty tank with inert gas; this process is called "purging." See Appendix A1.1.1.1 for a more detailed discussion of purging.

The lack of a clear definition of tanker fleets over the life of the project and the strong influence of nonsegregated ballasting on oxidant air quality in Los Angeles necessitated an analysis of impacts due to various ship combinations. Since SOHIO tankers would be equipped to burn fuel containing a lower sulfur content, various tanker combinations also have a bearing on SO_2 levels in Long Beach Harbor. The annual frequency of occurrence of these scenarios has been estimated on the basis of tentative assumed tanker fleet configurations for the proposed project.

Port Valdez. There are substantial hydrocarbon vapor emissions expected as well from tankers at Port Valdez (see Figure 2.1.1.1-2). In the loading phase, as crude oil is introduced into a tank, the vapors are expelled in a manner similar to those that occur when an automobile gasoline tank is filled.

The Final Environmental Impact Statement for the Trans-Alaska Pipeline (1972) evaluated air quality impacts of port facilities but did not quantify those resulting from loading crude oil into tankers. Subsequently, Alyeska Pipeline Service Company collected baseline air quality and meteorological data in the Valdez basin. The Bureau of Land Management directed its contractor, Environmental Research and Technology, Inc. to analyze the

Alyeska data in light of projected emissions from tanker fleets, with and without the SOHIO project (BLM (2)).

The ERT study identified adverse climatological factors which include frequent stable air; a very low thermal inversion lid that confines air pollutants; frequent low wind speeds in the port; and sufficient sun during the summer to stimulate production of oxidant. A summary of key climatological factors is given in Section 2.1.1.1.

The ERT study assumed a total loading of 1,200,000 barrels per day from the pipeline at the Valdez terminal, regardless of the final outcome of the SOHIO project. Hyrdocarbon (HC), nitrogen oxides (NOx), and sulfur dioxide emissions from loading tankers were identified. Realistic worse case scenarios compared emissions from SOHIO and non-SOHIO tankers. Baseline emissions from other sources were quantified.

Worst cases (during summer) were based on various combinations of NOx generated by some tankers discharging ballast while other tankers were releasing HC in the loading process. The computer modeling was similar to that employed in the study of the Los Angeles Air Shed, as described in Appendix A3.1.6, but computer runs were characterized by uniquely high concentration of hydrocarbons relative to available NOx. Scenarios involving tankers pumping clean ballast from dedicated (segregated) ballast tanks into the harbor waters yielded the highest ratio. The high HC ratio to NOx at Valdez offered unique computer problems. Two problems arose: (1) In combination with the adverse meteorology, computer runs yielded rapidly forming high levels of oxidant. (2) Owing to insufficient NOx, the computer runs often terminated prior to the air parcels reaching Valdez City. Approval of the SOHIO project would provide more tankers with segregated ballast for the Alaska trade; but no clear advantages or disadvantages could be positively identified in the study. Similarly, the possibility of high levels of sulfur dioxide near the terminal was identified. Frequent occurrences of a low thermal inversion lid and wind toward shore can result in severe impacts along the shoreline as a result of the trapping of ambient sulfur dioxide and then movement down the steep slope that forms the southern boundary of the terminal. Modeling calculations indicate that under the most severe conditions concentrations as high as 6,700 ug/m^3 (three-hour average) could be experienced (the Federal three-hour standard is 1,300 ug/m^3). See Supplemental study on Valdez Air Quality. As in the case for oxidant, this problem will occur with or without approval of the SOHIO project.

Some caveats about the accuracy of the modeling are in order. A situation with such high HC to NOx rations has never been validated by field measurements. There have been few instances where computer models have been specifically adapted to treat reactive point sources such as those associated with the SOHIO project, and little effort at validation to date has been expended. The models used by the contractors studying the SOHIO project have been validated for oxidant generated from regional (i.e. slow varying in space and time) emissions in Los Angeles. These models are sensitive to the methods used in distributing initial emissions among the computer grid squares when modeling point sources.

In summary, the results of this study are suggestive only. Air quality in future years with or without the proposed project cannot be predicted on the basis of studies provided for this document. No incremental change can be specified at this time.

Impacts in coastal waters. Some emissions from tankers in coastal waters migrate inland (see Section 2.1.6.1). The California Air Resources Board is currently negotiating with SOHIO to determine the amount of trade-offs necessary to compensate for emissions arising from SOHIO tankers that would migrate over the Los Angeles Air Shed.

Few, if any, attempts have been made to record the ambient level associated with an emissions plume from a ship offshore. If levels were frequently significant, the rise and fall in level owing to a ship passing offshore would have been noticed in data recorded on air quality monitoring instruments in coastal areas. The contractors for the California Final Environmental Impact Report (FEIR) and for this document have calculated maximum peak concentrations and arrived at similar conclusions (Port of Long Beach/PUC, 1977). The study for the BLM is available upon request (BLM, 1977).

The maximum ambient level would occur when the wind, carrying the emissions onshore, would blow perpendicular to the shoreline. ERT found that the wind is from the south to southwest (on average perpendicular to the general northwest to southeast strike of the mainland) from 3 to 12 percent of the time, with the higher frequencies occurring in the spring and summer for wind trajectories that would impinge on eastern Ventura and all of Los Angeles counties (from Latitude 33.5°N to 34°N). Impacts were calculated assuming the tanker would be steaming at 15 knots while 5 miles offshore parallel to the coast with the wind perpendicular to shore and at various intensities; a full range of meteorological conditions were examined (see Appendix 3.1.6 for a general discussion of methodologies; the method used was a modification of those used in modeling the impacts upon the Los Angeles Air Shed).

Even under the assumption of maximum tanker emissions (a 120,000 DWT tanker burning 3 percent sulfur content fuel) ambient sulfur dioxide concentrations were much too low to have an effect on any sulfur dioxide standard (the most pertinent standard is the California 1-hour standard of 0.5 parts per million [ppm]). The worst case resulted in a peak level of 0.02 ppm, a level that would be sustained for about 6 minutes and seldom, if ever, more than 15 minutes.

Hydrocarbons (HC) and nitrogen oxides (NOx) emissions from tankers could give rise to easily detected peak oxidant levels recordable onshore (purging would have to occur simultaneously with worst case modeling and meteorological assumptions; these events would, therefore, be infrequent). The maximum peak increment (under worst case assumptions) that was calculated by ERT was 0.12 ppm. The increment occurred in Simi Valley assuming regional growth as projected for 1983. The corresponding 1-hour average increment would be 0.01 to 0.02 and at most 0.03 ppm; the low average value results from the rapid movement of the plume, and is less than the Federal oxidant 1-hour standards of 0.08 ppm. The baseline oxidant level on the day modeled was 0.17 ppm. Typical peak levels arising from purging were found to be about 0.03 to 0.08 ppm; and from this it is estimated that 1-hour average incremental levels would be about 0.01 ppm. Levels simulated off Ventura County were higher than those off Los Angeles County; this is attributed to the lower levels of available NOx off Ventura County (see the discussion on the HC to NOx ratio in the Valdez study, above). Both this study and the one for the FEIR assumed no reaction of HC and NOx until emissions were onshore; this is a simplifying but conservative assumption . Incremental levels of oxidant resulting from adjustment of ballast on partially segregated tankers were found to be 6 to 18 percent lower. The ballasting scenarios are unrealistic since the assumed adjustment of ballast would normally occur during stormy weather, a time when oxidant formation is retarded.

Oil storage tanks. Fugitive hydrocarbon emissions would be generated by the floating-roof storage tanks constructed for the project. The plans call for eight 615,000-barrel tanks in the Los Angeles area: six at Pier J in the harbor, and two at the Dominguez Hills terminal about 8 miles inland. At the Midland terminal in Texas, there would be four 500,000-barrel receiving tanks. Service tanks in conjunction with pressure relief valves along the pipeline would be used to accommodate sudden pressure changes. An 80,000-barrel tank is planned near Indio, and a 10,000-barrel tank near Redington. Under normal conditions these tanks would be dry. Each group of tanks (eight in Los Angeles and four in Midland) could receive the full pipeline flow as throughput. Normal operation would be to "float" the tanks on the line. For example, during the tanker unloading operation, crude oil would be transferred at 125,000 bbl/hr to the Long Beach terminal tankage. Transfer of crude from the Long Beach terminal to the Dominguez Hills terminal would be at the nominal rate of 29,200 bbl/hr. Thus the Long Beach tanks would receive only 76 percent of the full pipeline flow. Normal operation would be to have the oil destined for Midland (500,000 bbl/d, out of 700,000 total) bypass the two tanks at Dominguez Hills. The delivery rates from the Midland terminal would fluctuate with demand. Under steady flow conditions, crude oil would not be transferred directly to storage but to the delivery lines with only a small portion of the oil flowing to the tanks.

The rate of emission of hydrocarbons would depend principally on two factors: (1) evaporation past seals on the floating roofs and through ports ("standing losses"), and (2) evaporation from the inner walls when the floating roofs descend during emptying ("wetting losses"). Losses from valves and pipeline seals would be much smaller (Appendix A3.1.6.1).

Oil refining. Based on the best available information, it is expected that construction and operation of the project would result in no net change in refinery throughput (see Section 3.1.16.5, Energy supply and demand). Construction of Pier J would immediately increase capacity of the Port to discharge crude oil to southern California refineries. Other regulations (see Section 2.1.6.5 and Appendix A3.1.6.1.2) prevent a net increase in emissions from refineries. Since refineries in southern California are running at full effective capacity, no change in HC or NOx emissions from refineries is expected as a result of the project. Although the sulfur content of the feedstock may be altered, this cannot result in sulfur oxides (SOx) emissions exceeding 90 kg/hr per sulfur recovery unit under current South Coast Air Quality Management District Rule 468. If the throughput remains constant, the number of recovery units and hence emissions of SOx should be unchanged. Thus, secondary emissions as a result of project-related changes in oil refining operations in Los Angeles have been omitted from consideration.

Power generation. Substantial amounts of electrical power would be required to operate the marine terminal and pump stations along the pipeline (156,000 hp requiring 116 megawatts [Table 1.2.3.2-24]). Power demand would be constant and essentially unvarying, and hence would become a part of the base load of the electrical supply network in the vicinity of each station. Within the Los Angeles Basin it is expected that the new base-load increment would be satisfied in large part by generating facilities outside the basin which may be of several types (nuclear, coal-fired, oil, hydroelectric). Along the rest of the pipeline route, power demands would be supplied from extensive rural networks, again making it difficult to identify the types and locations of the generation facilities supplying the power. Emissions and air quality impacts are estimated for a worst case -- all power generated at Four-Corners using coal (Section 3.1.6.2.2). In addition, the impact is estimated as if the two Los Angeles Air Shed pump stations were supplied by local oil-burning electrical utility stations (Section 3.1.6.1.2).

Impacts resulting from air pollution

Air pollution degrades human performance and health, and public welfare. Air quality standards serve as a bench mark to indicate impact. National standards are twofold: The primary standards were established to protect the public health with a margin of safety; the secondary standards serve the same purpose for public welfare. It would be desirable to quantify the health impacts of air pollution (numbers of premature deaths per day in each age group, etc.). Unfortunately, the data are principally statistical and the quantification uncertain. Since primary air quality standards have been set on the (uncertain) basis of health effects, and since they will be key criterian in determining the acceptability of the proposed project, this chapter references the significance of impacts solely against air quality standards. See Section 2.1.6.5 for a discussion of standards and a summary of the relationship of standards and ambient levels to socioeconomic factors in completing the air quality impacts assessment. In Chapter 8, the socioeconomic factors are included in comparing air quality impacts of alternative sites to the project as proposed.

3.1.6.1 Los Angeles Air Shed

Tables 3.1.6-1 and 3.1.6-2, displayed earlier, indicate that oxidant, sulfur dioxide (SO_2), and total suspended particulate (TSP) levels in the Los Angeles area may be impacted to some extent by nearly all of the project-related sources, either during the construction phase or during subsequent operation of the project. The following sections present the expected pollutant emission levels from the relevant sources during construction and operation of the proposed project.

3.1.6.1.1 Construction

Table 3.1.6.1.1-1 presents emission levels during construction in the Los Angeles Air Shed, as calculated in Appendix A3.1.6.1. Construction of the pipeline segments would take about five months, and the other facilities somewhat over one year (Chapter 1).

Table 3.1.6.1.1-1

Computed Construction-Phase Emissions (lb/d)

Los Angeles Air Shed

LOCATION	HC[a]	NOx[a]	SO_2[a]	Particulate Emissions[b]	Fugitive Dust[c]	CO[a]
Port terminal[d]	94	582	43	28	340	798
Dominguez Hills terminal	73	368	27	20	200	664
Pier J to Walnut[e]	536	3,426	253	158	420	6,370
Walnut to Beaumont	338	1,950	145	97	530	2,937

[a] Symbols: Hydrocarbons; oxides of nitrogen; sulfur dioxide; carbon monoxide.

[b] Particulate emissions arise from exhaust and tire wear.

[c] Fugitive dust is airborne pulverized soil particles.

[d] These estimates do not include emissions related to marine construction. The latter are given in Appendix A3.1.6.1.

[e] Pipeline construction by seven crews in the heavily urbanized first segment of pipeline construction.

Realistic worst case calculations for ambient concentrations of air pollutants from these emission levels were calculated for meteorological conditions in the Long Beach area on 1 March 1975. On that date, the air quality monitoring station at Long Beach recorded its highest sulfur dioxide level for the year, 0.064 ppm (Table 2.1.6.2-1). Dispersion of air pollutants was severely limited by a low mixing height and generally low wind speeds (Appendix Table A3.1.6-1). See Appendix A3.1.6 for details of the methodology.

Oxidant

The substantial project-related source of oxidant precursor emissions during the construction phase of the project would be the heavy duty construction equipment itself.

The total hydrocarbon emissions shown in Table 3.1.6.1.1-1 (1,041 lb/d) represent 0.04 percent of the estimated HC emissions in the entire air shed during construction (interpolation in Table 2.2.6.1-4); similarly, the NOx emissions (6,326 lb/d) represent 0.25 percent (Table 2.2.6.1-3). These emissions would react with other pollutants as they move downwind. The NOx emission rates are comparatively higher than those for HC; as a result, there would be some chemical combination of exhaust nitric oxide (NO) with ambient ozone to form ordinary oxygen and nitrogen dioxide (NO_2) in the area downwind of construction, but the NOx emissions are not large enough to have a significant effect on regional oxidant levels.

The diffusion modeling predicts the following one-hour average realistic worst case NO levels at a distance of 1,640 feet (500 meters) downwind from construction sites: 1,000 $\mu g/m^3$ near construction of the Port terminal; 800 $\mu g/m^3$ near the first pump station; 1,600 $\mu g/m^3$ near each of the pipeline construction spreads between Pier J and Walnut; and 500 $\mu g/m^3$ near the construction spread between Walnut and Beaumont. The concentrations for construction of the terminal and pump station sites decrease approximately 50 percent at twice the distance downwind from construction (3,280 feet or 1 kilometer). Levels would be expected to decrease at a slightly faster rate downwind from pipeline construction spreads.

There is no air pollution standard for the NO emitted by the construction equipment. NO would be thoroughly diluted before it is oxidized to NO_2 (for which there are air quality standards). Similarly, the diffusion modeling predicts realistic worst-case hydrocarbon levels (6 to 9 a.m. average) ranging between 27 and 71 $\mu g/m^3$ 1,640 feet (500 meters) downwind from construction sites. These values are less than half of the Federal hydrocarbon standard (160 μg/m³). Realistic worst case levels drop to 15 to 22 μg/m³ at twice the distance. Ambient levels in the port area can be expected to exceed the hydrocarbon standard during such severe meteorological conditions as those used in the modeling.

Sulfur dioxide

Projections of ambient SO_2 levels without the project to 1980 (Section 2.2.6.1) show values probably in excess of the national and state 24-hour standards at locations primarily north of Long Beach. Sulfur dioxide emissions from the construction phase of the project would be attributable to fuel burning by construction equipment. Estimated SO_2 emissions for each construction phase are given in Table 3.1.6.1.1-1.

The total of listed sulfur dioxide emissions (468 lb/d) is 0.04 percent of estimated SO_2 emissions (574 tons per day) for the total air shed during construction (Table 2.2.6.1-1). Diffusion modeling predicts the following 24-hour average realistic worst-case sulfur dioxide ambient level increments at a distance of 1,640 feet (500 meters) downwind from construction sites: 10 μg/m³ near the Port terminal; 8 near the first pump station; 15 near each pipeline spread between Pier J and Walnut; and 4 μg/m³ near the construction spread that would be used to lay pipe between Walnut and Beaumont. (Maximum increments drop to 5 μg/m³ at 3,280 feet [1 kilometer] from construction.) These increments are considerably less than the California 24-hour standard (105 μg/m³); but the meteorology used in the modeling was taken from a day when the standard was exceeded. (The segment from Pier J to Walnut would be the most likely to have high ambient levels [Figures 2.1.6.2-6 and 2.2.6.1-1].) Both the increments resulting from construction and the ambient level would decrease during days with better atmospheric mixing.

The increment of sulfur dioxide resulting from construction would have a smaller impact on the other sulfur dioxide standards. The largest one-hour average increment was found to be 117 µg/m³ near the Pier J to Walnut construction spreads. This represents 9 percent of the California one-hour standard (1,310 µg/m³). The levels given above and ambient levels in construction areas can be expected to decrease on days with better atmospheric ventilating characteristics.

Total suspended particulates (TSP)

Particulate standards are frequently exceeded in the Los Angeles Air Shed (Section 2.2.6.1). Construction-related impacts on particulate air quality, although significant, would be very local in nature and should not adversely affect total air quality except in regions of high existing particulate concentrations (such as the Walnut to Redlands segment of pipeline construction [Figures 2.1.6.2-8 and 2.2.6.1-3]).

Particulate emissions arising from exhaust and tire wear are given in Table 3.1.6.1.1-1. Fugitive dust is airborne pulverized soil, and these emissions are also given in the table. The rates of dust emissions for terminal and pump station sites were derived from measurements at semiarid sites with a median level of activity and a soil silt content of 30 percent; rates were reduced 50 percent on assumption of dust-control watering. Although water is readily available for watering at pipeline construction sites in the Los Angeles area, emission factors for all pipeline segments assume no dust-control watering (see Appendix A3.1.6.1 for additional details). Fugitive dust emission factors should be considered only approximate, owing to the many assumptions involved. Maximum emissions of combined particulate during construction were estimated at 1,800 lbs/d (less than 0.2 percent of the estimated daily rate for the entire air shed; Table 2.2.6.1-2).

Diffusion modeling predicts the following 24-hour average realistic worst-case particulate ambient level increments at a distance of 1,640 feet (500 meters) downwind from construction sites: 86 µg/m³ near the Port terminal; 65 near the first pump station; 35 near each pipeline spread between Pier J and Walnut; and 19 μg/m³ near the pipeline spread in the Walnut to Beaumont segment. These worst-case estimates represent a considerable fraction of the California 24-hour standard (100 μg/m³). The largest anticipated increment at 3,280 feet (1 kilometer) is 36 μg/m³ in the vicinity of the Port terminal. Construction increments and ambient levels would be considerably lower on days with more favorable atmospheric mixing. Increments would vary considerably with the level of dust-control watering employed on any given day.

Carbon monoxide

Carbon monoxide (CO) emissions from construction equipment (Table 3.1.6.1.1-1) would result in increments considerably smaller than the levels in the CO standards. The largest one-hour average increment at 1,640 feet (500 meters) was estimated to be 3 mg/m³ at construction spreads between Pier J and Walnut; this is 7 percent of the one-hour standard (46 mg/m³). The largest 8-hour increment at 1,640 feet was estimated to be 1 mg/m³ near the same pipeline construction spreads; this is 10 percent of the 8-hour standard (10 mg/m³).

Carbon monoxide emissions would also result twice a day from commuting by construction workers. Appendix A3.1.6.1 includes emissions from all sources during construction. Consultants for the Port of Long Beach estimate that there will be approximately 23,000 pounds of carbon monoxide emitted per day during construction in southern California. Other figures are 14,075 pounds per day in the Los Angeles Air Shed, and 4,646 pounds per day in the area associated with construction of the marine terminal.

The area that would most probably see measurable increases in ambient CO levels would be the Long Beach area. The California 10 ppm (12-hour average) CO standard was exceeded 34 times, and the Federal 9 ppm (8-hour average) standard was exceeded 57 times, at the Long Beach monitoring station during 1975. A comparable project for which a study was performed, found that roadside levels would rise approximately 1 ppm during approximately one hour twice daily as a result of commuting by about 700 construction workers (Oxnard, 1976). Since the marine terminal construction would involve fewer workers (257), the increase in level would be less than 1 ppm. A comparison of this short-term impact with the carbon monoxide standards (above) indicates there would be low probability of the project causing a CO standard to be exceeded.

At all other construction locations, the impacts would be smaller than those for the marine terminal. Fewer workers would be involved, and ambient concentrations of CO are lower elsewhere in the project area. The California one-hour carbon monoxide standard (40 ppm) was not exceeded during 1975 near the proposed construction corridor.

3.1.6.1.2 Operation

Oxidant

Emissions calculations. See Appendix A3.1.6.1 for assumptions and calculations. Table 3.1.6.1.2-1 summarizes photochemically significant hydrocarbon vapor emission rates for the oil storage tanks as calculated by the conventional American Petroleum Institute method.

Table 3.1.6.1.2-1

Calculated Reactive Hydrocarbon Emissions From Oil Storage Tanks[a] in the Los Angeles Basin

LOCATION	Standing Evaporation Loss[b]	Withdrawal Losses Project[b]	Total Emissions Project[b]
Dominguez Hills facility (2 tanks)	544	51	595
Pier J (6 tanks)	1,631	153	1,784

[a] Assumption: American Petroleum Institute method of calculating vapor emissions (Appendix A3.1.6.1).

[b] Pounds per day.

In terms of oxidant production, which is primarily fed by reactive hydrocarbon emissions, the most crucial tanker operation is ballasting into cargo tanks on tankers which do not have sufficient segregated ballast tankage. Assuming as a worst case that the smaller 70,000 DWT class tankers have insufficient segregated ballast tanks, two scenarios have been evaluated which include them. The worst case situation has three such tankers in-berth and taking on ballast simultaneously. In the second scenario, only one 70,000 DWT tanker is in-berth and ballasting into cargo tanks. Two additional scenarios evaluate the impact of the Pier J storage tanks alone, in the absence of any tanker operations, and the impact of the substantial stack emissions of NOx which occur if three of the 165,000 DWT tankers (with fully segregated ballast) are pumping simultaneously. Table 3.1.6.1.2-2 contains the HC and NOx emissions from tanker stacks, and Table 3.1.6.1.2-3 gives expected frequencies of occurrence of the postulated tanker scenarios.

Table 3.1.6.1.2-2

Calculated Pollutant Emissions During Pumping by Tankers

		Pollutant Emissions from Ship's Stack	
CASE	Tanker Scenario[a]	HC[b]	NOx[b]
1	3 - 70,000 DWT[c] Tankers	5.22	193
2	1 - 70,000 DWT Tanker	1.74	64.4
4	3 - 165,000 DWT Tankers	10.6	390

[a] See Appendix Table A3.1.6.1-4 for cargo capacities.

[b] Pounds per hour.

[c] Deadweight tonnage. The total weight capacity of a ship expressed in long tons (2,240 lbs.). Displacement of a fully loaded ship, less the displacement when empty.

Lacking specific data for the smaller tankers, the emission rates shown here for the 70,000 DWT tankers are based on data for 80,000 DWT SOHIO tankers. The details of these emission calculations are given in Appendix A3.1.6.1.

Table 3.1.6.1.2-3

Calculated Frequencies of Occurrence for 14-Vessel Tanker Mix[a]

		Expected Annual Frequency of Occurrence	
CASE	Tanker Scenario	events per year[b]	hours per year
1	3 - 70,000 DWT tankers ballasting	0.005	0.01
2	1 - 70,000 DWT tanker ballasting	71	157
4	3 - 165,000 DWT tankers pumping	0.42	4.7

[a] See Appendix A3.1.6.1 for derivations.

[b] Data for cases 1 and 2 in the first column represent 1/2.2 of the data in the second column, where each ballasting operation is assumed to take 2.2 hours. For case 4 the reduction is by 1/11, where each pumping operation is estimated to take 11 hours.

It was found that the small tankers may be required to take on up to 20 percent by volume of nonsegregated ballast for safe operation in leaving the harbor. The resulting hydrocarbon vapor emissions have been estimated using data presented in a recent paper by MacKenzie and Rau (MacKenzie, 1976). The average emission factor chosen is 1.2 pounds per thousand gallons for a ship of comparable size, with about 4,500 pounds of photochemically reactive hydrocarbons released to the atmosphere in about 2.2 hours of ballasting. (In the MacKenzie study there were no measurements comparable to the SOHIO case. Case II in Table II was estimated to represent about the right emission factor; this factor is higher than the one given for loading crude oil, but the Alaskan oil will have a higher vapor pressure. After the Alaska terminal comes on-line, measurements similar to those in the MacKenzie paper will be possible.)

The expected oxidant impacts arising from the described emissions have been evaluated using the ERT ARTSIM model along the two trajectories shown in

Figure 3.1.6.1.2-1. The emissions modeled for the Dominguez Hills terminal are those shown for the project in Table 3.1.6.1.2-1. The emission rates used for the four scenarios involving the Pier J facilities are totaled in Table 3.1.6.1.2-4.

Table 3.1.6.1.2-4

Calculated Project-Related Emissions of HC and NOx for Pier J Scenarios

		Total Pollutant Emissions (lb/hr)	
Case	Tanker Scenario	RHC[a]	NOx
1	3 - 70,000 DWT, ballasting	6,239	193
2	1 - 70,000 DWT, ballasting	2,129	64.4
3	Pier J storage tanks only	74.3	0
4	3 - 165,000 DWT, pumping	84.9	390

[a] Photochemically reactive hydrocarbon fraction (RHC). Modeling was based on ignoring the methane and ethane fractions as nonreactive. The Environmental Protection Agency, however, considers the ethane fraction as reactive; they use the term "nonmethane hydrocarbons."

Oxidant impacts

Following the procedures described in Appendix A3.1.6, oxidant concentrations with and without the project scenarios were compared at 1230 hours PDT on the Dominguez Hills site trajectory and 1200 hours PDT on the Pier J trajectory (the times when the peak in oxidant levels occurs; see Figure 3.1.6.1.2-1). Table 3.1.6.1.2-5 shows these comparisons and tabulates percentage changes in oxidants as well. Oxidant concentrations downwind from Pier J without the project are seen to be at the level of the National Ambient Air Quality Standard (0.08 ppm, one-hour average). Since the base day modeled, although severe, did not represent a day with worst annual oxidant levels (needed data were not available for the worst possible oxidant day), it must be assumed that the area would be in violation of the

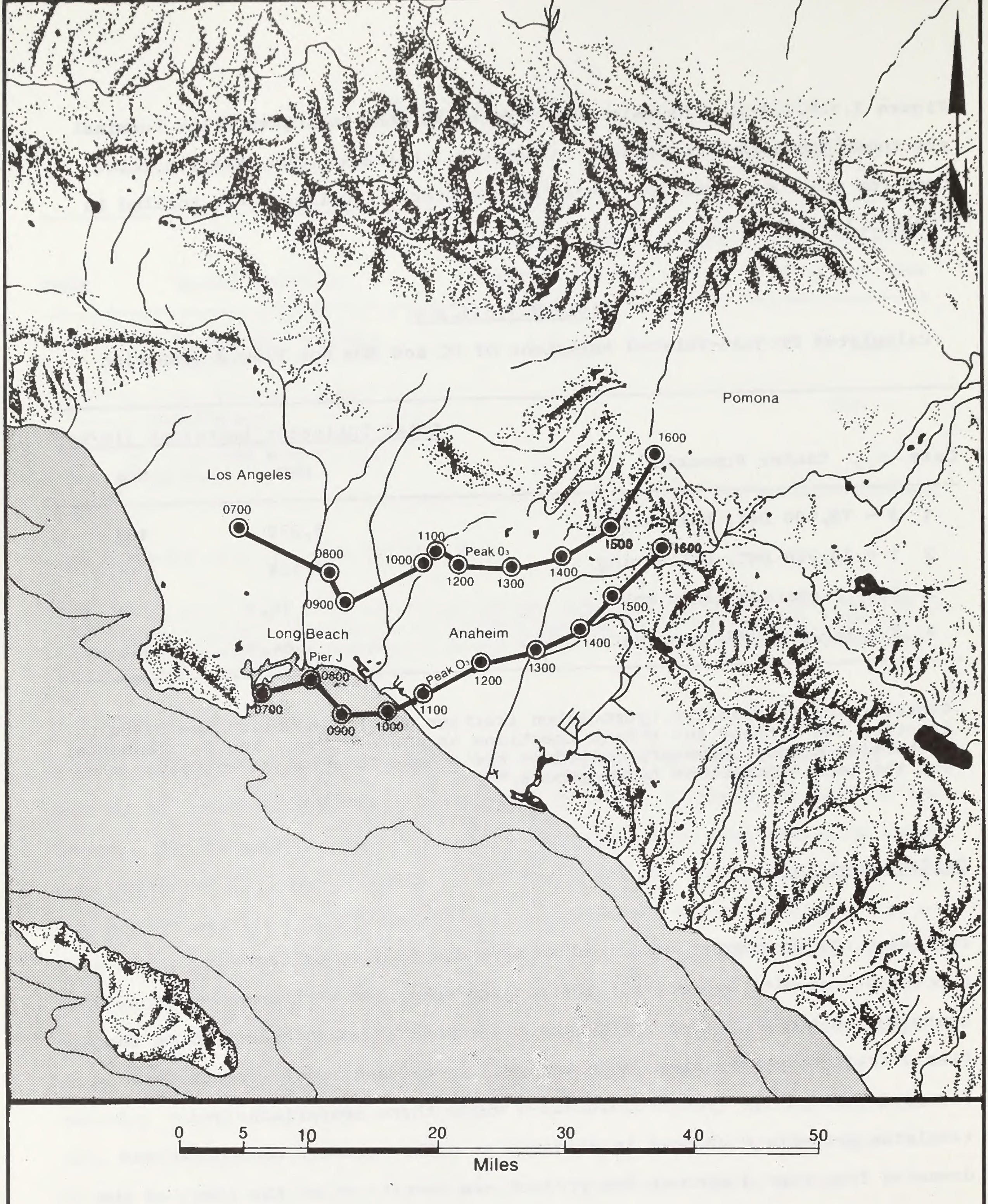


Figure 3.1.6.1.2-1 Selected trajectories for oxidant impact evaluation during daytime hours

standard before the project is added (see Air quality trends and Photochemical oxidants in Section 2.1.6.2).

Table 3.1.6.1.2-5

Oxidant Impacts in the Los Angeles Air Shed - 1980

		Dominguez Hills Trajectory		Pier J Trajectory	
CASE	Tanker Scenario	O_3, pphm[a]	% Increase	O_3, pphm[a]	% Increase
0	No Project	6.93		8.39	
1	3 - 70,000 DWT tankers			15.93	89.9
2	1 - 70,000 DWT tanker			10.41	24.1
3	Storage tanks only	6.97	0.6	8.47	1.0
4	3 - 165,000 DWT tankers			N/A[b]	N/A[b]

[a] 100 parts per hundred million (pphm) equals 1 ppm.

[b] Chemical combination of stack-emitted nitric oxide (NO) with ambient ozone (and other oxidants) to form ordinary oxygen and nitrogen dioxide through 1600 PDT when the computer simulation was terminated.

Thus, the increased oxidant levels indicated for the tanker scenarios translate into increased frequencies of violation. One should be cautious of interpreting absolute concentration levels predicted by an air quality model because of the many uncertainties associated with the estimation of future pollutant emissions and their geographic distribution. It is generally safer to consider the relative changes in concentration resulting from the addition of the project under evaluation. In terms of relative impact, it is clear from Table 3.1.6.1.2-5 that the impact of the oil storage tanks alone is small. This is not true, however, with the tanker ballasting scenarios. Even a single 70,000 DWT tanker ballasted at the wrong time of day could have a significant effect on downwind oxidant levels.

The American Petroleum Institute (API) method of calculating fugitive hydrocarbon emissions has been based on earlier designs of floating roof tanks. Many persons from industry and air pollution agencies have indicated that there is a need to verify the calculations and produce new computational methods if necessary. A recent study on model tanks by Chicago Bridge and Iron (CBI) proposes emission rates which are 8 to 10 percent of those predicted by the API method for a full-size tank with double seals on the floating roof (CBI, 1976). A study by Engineering-Science, Inc. (1977) on standing losses from selected tanks in Los Angeles and San Francisco found a spread in emission rates that averaged approximately 50 percent of the API rate. Environmental Research and Technology assumed a somewhat lower rate (22 percent of API) to give credit to the expected use of more modern seals and reran the photochemical diffusion model. However, since the oxidant impact of the oil storage tanks alone is minimal using the API method, the effect of assuming lower emissions instead would be relatively unimportant as is seen by comparing Table 3.1.6.1.2-6 with Table 3.1.6.1.2-5.

Table 3.1.6.1.2-6

Modified Oxidant Impacts Using CBI Emissions Estimates

			Trajectory			
	Modified 1980 RHC Emissions (lb/hr)		Dominguez Hills		Pier J	
CASE	Dominguez Hills	Pier J	O_3, pphm[a]	% Increase	O_3, pphm[a]	% Increase
0	0	0	6.93	0	8.39	0
1		6,181			15.86	89.0
2		2,071			10.35	23.4
3	5.45	16.3	6.94	0.1	8.41	0.2

[a] 100 pphm equals 1 ppm.

Probability of impact. In order to evaluate the likelihood of the hypothetical Pier J scenarios, it is necessary to estimate the number of calls at Long Beach that would be made annually by each of the different tanker types in the fleet. Calculations have been made for the realistic fleet most likely to involve significant oxidant impacts. The discussion in Appendix A3.1.6.1 shows how to make similar calculations. These calculations account for the annual probability of occurrence of key events included in the various air quality impact scenarios evaluated for Pier J. Based on these probabilities, Table 3.1.6.1.2-3, above, shows the expected number of times per year that each situation would occur. The frequencies for the 70,000 DWT tankers in Table 3.1.5.1.2-3 must be scaled down by about a factor of 6 to represent events likely to be associated with maximum oxidant production. The emissions must be released in the period from approximately 10 p.m. to 10 a.m. (causing a reduction of frequency by about 12/24) during smoggy weather (causing further reduction by about 1/3). It must be noted that these estimated frequencies of occurrence are dependent on the assumed fleet configuration which is still undefined and arbitrary at this time.

Accidental spills. According to analysis, approximately 25 percent of any North Slope oil spilled would evaporate in the first 24 hours; approximately 10 percent would evaporate in the first hour (Woodward-Clyde, 1976). Consequently, oxidant impacts cannot be prevented by any means when significant quantities of oil are spilled. The impact depends on the size of the spill, its location relative to populations, and the intervening meteorology and terrain conditions. The actual spill size or sizes that would occur are unknown since there would be very few events (see Summary in Section 3.1.5.1.2 and Appendix A1.1.1.1-A for more detail). A spill in the Port of Long Beach area of around 200 barrels would approximate the quantities of hydrocarbon vapors released by ballasting into cargo tanks. If this occurred during night or morning hours under low inversion conditions (usually summer), oxidant levels similar to those modeled could be expected downwind of the spill; that is, oxidant levels could increase a modest 25 percent, could double, or from a much larger spill, could even reach record oxidant levels. A spill of at least 200 barrels under low inversion conditions, or a larger one under less severe weather would probably occur at least once during the life of the project in California coastal waters. The impact on oxidant levels could range from minor to very severe. If severe, effects on health and human performance may be immediately detectable.

Summary of oxidant impact. One tanker taking on about 20 percent nonsegregated ballast at night or in early morning hours (see Section 2.1.1.2 and Figure 2.1.1.2-2 on nighttime atmospheric stagnation) during smoggy weather would result in about a 25 percent increase in oxidant levels downwind of Pier J. As the average of oxidant during the smoggy season downwind of Pier J has been approximately three-fourths of the ambient level (Figure 2.1.6.2-3) used in the definition of the national standard (0.08 ppm for a one-hour average not to be exceeded more than once per year), any ballasting by nonsegregated tankers could augment the number of days that would exceed the standard. Assuming the realistic worse case fleet used in the calculations (Appendix Table A3.1.6.1-9), at least one tanker with nonsegregated ballast would ballast in the port area up to 70 times per year. This ballasting would occur during adverse hours in the smog season (roughly mid-June to late September; and thereby result in maximum oxidant production) up to 12 times per year. Similarly, two of these tankers would ballast simultaneously approximately 1.9 hours per year (almost one event per year); and under conditions resulting in maximum oxidant production approximately once every 7 years. Some other events have probabilities either too low or too uncertain to allow a clear conclusion that they would have an impact on attaining the oxidant standard, but have potential direct and secondary impact on oxidant air quality. These include three such tankers ballasting in the same adverse time slot (about one hour every 89 years, or one event every 196 years), or a tanker purging between San Pedro Bay and Point Conception during adverse meteorology (it will be impossible to collect valid statistics on this event without installing electronic monitoring equipment on tankers; see Section 4.3.2 on Proposed Mitigating Measures; see Section 3.1.6 under Impacts in Coastal Waters for estimated oxidant levels). Of more consequence is a major oil spill in coastal waters (once or twice in the life of the project in the southern California coastal area; see Section 3.1.5.1.2 and Appendix A1.1.1.1-A). Any oil spillage releasing at least 200 barrels can have an impact on oxidant air quality (all but the larger and least frequent spills can be discounted). A large spill under adverse meteorological conditions would cause record oxidant levels and secondary impacts. Purging in port, under the worst assumptions, could also result in very high oxidant levels; effective monitoring during off-loading by an enforcing agency could eliminate purging in port. (To roughly estimate maximum 1-hour average incremental oxidant levels from spills of 200 to 500 barrels in coastal waters use the peak oxidant levels given in Section 3.1.6 under Impacts in Coastal Waters. Purging in port would result in about a 33 percent increase in oxidant levels downwind of Pier J during adverse meteorology.)

Nitrogen oxides

The emission rates in Table 3.1.6.1.2-2 for tanker offloading are based on the EPA emission factor for steamships burning residual oil (Appendix Table A3.1.6.1-5). There is, however, very little measured data available on marine boilers. To fill this gap, the applicant contracted for Scott Environmental Technology, Inc. to make NOx emissions measurements during offloading from the British Petroleum tanker, British Renown, during December, 1976 (SOHIO, 1977). The average emission factor derived by Scott (1.5 lbs/bbl NOx) is considerably less than the EPA figure (2.67 lbs/bbl). The actual measured emission rate varied during the 15 hours of measurements. The maximum of the short period (up to 1 hour) averages (21 in all) just exceeding the EPA figure. The EPA emission factor then serves as a valid basis for worst-case calculations of 1 hour average ambient concentrations of NO_2 downwind of a tanker.

As part of the process of establishing emission tradeoffs, the applicant was asked by the South Coast Air Quality Management District to develop the "highest operational mode (for tankers) realistically expected at the facility". The applicant determined this to be two SOHIO 165,000 DWT tankers offloading simultaneously (an event SOHIO calculated to occur about once per year; this frequency is lower than the one derived in Appendix A3.1.6.1 [about 7.5 events per year], and is also lower than the frequency that can be deduced from SOHIO's 1976 report, Berth and Tanker Study). Diffusion calculations using two models were performed to obtain maximum expected ambient concentrations of SO_2, NO_2, and particulates under this realistic worst-case assumption.

In calculating ambient NOx levels, the nonphysical worst-case assumption was made that all stack nitric oxide (NO) would be immediately converted to NO_2. Using the average emission factor, both the PTMTP (EPA) and APMAX (Engineering-Service) models gave ambient concentrations below the California 1-hour NOx standard. The calculated NOx ambient concentrations remain below the standard when scaled to correspond to the higher EPA emission factor. Calculations of ambient concentrations and related information are given in Table 3.1.6.1.2-7.

Table 3.1.6.1.2-7

Predicted Maximum Pollution Concentrations

CONTAMINANT	Averaging Time	Maximum Concentration for[a]				Air Quality Standards (ppm)
		Average Emission Rate		EPA (or Peak) Emission Rate		
		PTMTP	APMAX	PTMTP	APMAX	
SO_2	1 hour	.06	.09			.50[b]
	24 hours	.01	.03			.04[b]
	24 hours	.01	.03			.14[c]
NO_2	1 hour	.05	.08	.09	.14	.25[b]
Particulates	24 hours	3.00[d]	8.00[d]			100.00[b,d]

Source: SOHIO, 1976.

[a] All concentrations in ppm, except for particulates. These are incremental values that are to be added to the corresponding background levels. On the day modeled the background SO_2 level (.064 ppm) exceeded the California standard. (In general, when the background level is higher, the impact tends to be most severe.)

[b] California air quality standard.

[c] Federal air quality standard.

[d] Concentrations in $\mu g/m^3$.

Hydrocarbons

The Federal 0600 to 0900 (6 a.m. to 9 a.m.) hydrocarbon standard (0.24 ppm) was instituted as an aid in attaining the oxidant standard. The hydrocarbon standard, like the oxidant standard is exceeded on most days where measured. This standard is measured neither at the Long Beach monitoring station, nor at several other stations in the urban Los Angeles area.

A representative calculation for impact of the project upon the standard is the following. The maximum concentration of hydrocarbons downwind from a storage tank was found to be 426 $\mu g/m^3$. Assumptions used were the total emission rate in Table 3.1.6.1.2-1, wind speed of 1 meter per second, and emissions calculated as propagating from the top of the tank as a finite line source. These are realistic worst-case assumptions. Highest concentrations under realistic assumptions were found to occur 375 meters downwind under Class D atmospheric stability conditions. The concentration represents a short (three-minute) averaging time.

In general, it has been found that when averaging, the drop in value (owing to wandering of the wind) is at least 50 percent for a three-hour averaging period. The estimated maximum concentration for a three-hour average then becomes 217 $\mu g/m^3$. Using the mean molecular weight of the propane through pentane fraction of North Slope crude oil (45 from Appendix Table A3.1.6.1-7 and the conversion factor for deriving concentrations in ppm [see Conversion Table in the Appendices Volume]), the maximum estimated hydrocarbon concentration becomes 0.12 ppm. This calculation should be correct to within a factor of 2.

Two other factors approximately cancel: (1) the API emission rate should be excessive; but there would be (2) a small contribution to the ambient level from adjacent tanks. Therefore, by themselves, the tanks should not exceed the standard (0.24 ppm). Since the background ambient level would be frequently near or above the standard, the tanks would have a contributing influence. Ballasting into nonsegregated tanks would clearly exceed the standard. This is reflected in the much higher oxidant levels calculated to occur downwind.

Odors

Human ability to recognize the odors of sulfur-bearing compounds is highly developed. The presence of crude oil and its derivatives is recognized principally through sulfur-bearing compounds. These organic compounds represent up to several percent by weight of crude oil; only the lighter compounds, however, are sufficiently volatile to contribute to the characteristic odor of crude oil.

There is a consistent ranking of petroleum facilities in their likelihood of drawing attention by their associated odors. Refineries are the most obnoxious; producing oil wells, intermediate; and storage and pipeline facilities the least intrusive. Refineries release many odor-bearing compounds during the refining process. There is fairly frequent spillage and evaporation associated with separation of oil from formation waters in the extraction and gathering process. There are very small emissions associated with pumps and valves in the transportation process; odors are very infrequently noticed in proximity to storage tanks.

The calculation (426 $\mu g/m^3$) in the preceding section is useful in estimating the possibility of detecting odors from oil storage tanks. Extensive data and measurements would be required to make a precise determination of detectability of odor from this maximum concentration of HC. Two maximal cases can be easily calculated. First, assume all sulfur-bearing compounds are represented as 1 percent by weight of methyl mercaptan (CH_3SH); then the maximum concentration downwind would be 2 parts per billion (ppb). This is at the threshold of detectability of this compound (Williamson, 1973, pg. 16). A more realistic calculation is the following: Assume that sulfur-bearing compounds represent 1 percent by weight of the HC and have an average molecular weight of 100. Then the maximum concentration would be 1 ppb. This is below the threshold of detectability. Since it is improbable that all the worst case assumptions would be simultaneously realized, the likelihood of detecting odor from the tanks is slight. Odors could be detected after accidental spills, or sometimes in immediate proximity to loading or unloading operations.

Sulfur dioxide

The impact of tanker emissions at the Port is expected to be near Pier J, and the only significant ambient SO_2 concentration levels would be those for short time averages. The relatively low emission height and small exhaust heat rate from the tankers would cause maximum plume impact near the ships. Total annual SO_2 emissions of approximately 1,380 tons per year from the tanker fleet burning a mix of 0.5 and 3.0 percent sulfur oil would contribute approximately 0.6 percent to the year 1980 Los Angeles Air Shed SO_2 emissions (Table 2.2.6.1-1). Because of this relatively small annual emissions total, only short-term impacts are expected. To study this impact, point source Gaussian dispersion calculations were performed. Inputs to these calculations included calculated tanker stack parameters, SO_2 emissions, tanker mix, and worst-case meteorological conditions.

Stack parameters describing the emission characteristics of each tanker class are presented in Appendix Tables A3.1.6.1-4 through -6. The exhaust gas rate was calculated from fuel estimates for hoteling and the maximum pumping rate (Williams, 1976) using an air to fuel ratio of 14 with 10 percent excess air.

Sulfur dioxide emissions were calculated based on fuel consumption estimates of SOHIO (Williams Brothers, 1976), with fuel sulfur contents of 0.5 percent for SOHIO tankers and 3.0 percent for non-SOHIO tankers. Maximum and daily SO_2 emission rates for each tanker class are given in Table 3.1.6.1.2-8. Data in the table indicate that maximum emissions result from use of 3.0 percent sulfur fuel. As presently proposed, only SOHIO-owned vessels would have the segregated fuel tanks required to allow low sulfur fuel burning in port (Pacific Environmental Services, 1976). The case of all tankers burning 0.5 percent sulfur oil is examined as a mitigating measure.

The mix of tankers in port at any given time would determine the extent of impact on SO_2 levels in Long Beach. Data in Table 3.1.6.1.2-8 would indicate that the worst-case impact would be caused by the simultaneous discharge of crude from non-SOHIO 120,000 DWT tankers at proposed berths.

Table 3.1.6.1.2-8

SO_2 Emissions From Tankers Discharging at Pier J

TANKER TYPE	Maximum Emission Rate (Pounds/hr)	Daily Total Emissions (Pounds)
SOHIO:[a]		
120,000 DWT	137	1,955
165,000 DWT	161	2,272
Non-SOHIO:[b]		
80,000 DWT	481	7,043
120,000 DWT	824	11,730

[a] 0.5 percent sulfur oil.

[b] 3.0 percent sulfur oil.

Meteorologically the worst-case condition for dispersion of effluent from the tankers would be a high wind speed (21 mph) neutral condition. (A computer scan of weather data indicates that winds of this speed or greater occur about eight hours per year.) Under these atmospheric conditions, plume rise from the ships would be suppressed by the high speed winds, thus maximizing resultant ground level concentrations. Estimates of worst-case hourly SO_2 concentrations were made by assuming that, because of the distances separating the ship berths, the maximum SO_2 concentrations would be a result of alignment of two ship effluent plumes. For the three-hour averaging period, more variation in wind direction is expected as well as interaction between all three tanker plumes.

SO_2 impacts

Calculation of worst case short-term SO_2 concentrations was performed by the methods described in Appendix A3.1.6. The worst-case impact would result from the simultaneous discharging of oil from three 120,000 DWT non-SOHIO tankers burning 3.0 percent sulfur oil. Maximum predicted one-hour and three-hour SO_2 concentrations assuming alignment of ship plumes are 0.29 ppm (58 percent of the state hourly standard) and 0.20 ppm (40 percent of the three-hour standard) both at 3,300 feet (1,000 m). Values decrease rapidly at distances away from the pier so that hourly and three-hour concentrations at the beach in Long Beach (approximately 1.7 miles) are approximately 0.17 and 0.10 ppm. In calculating 24-hour average concentrations, worst-case meteorological conditions were assumed to persist for 12 hours with ship plumes aligned and emitting at the daily average emission rate (Table 3.1.6.1.2-8). Resultant 24-hour concentrations were 0.06 ppm at 3,300 feet (1,000 m) and less than 0.03 ppm at Long Beach. These results, when scaled to the tanker scenario represented in Table 3.1.6.1.2-7, are equal to those calculated by the PTMTP model. Emissions from exclusive burning of 0.5 percent sulfur fuels would contribute 386 tons per year or approximately 0.16 percent of the SO_2 emissions in the air shed.

Emission from electrical generation. Various emissions from electrical generation would have considerable magnitude. Each of the two pump stations in the Los Angeles Air Shed would require 7 megawatts at rated capacity. The total demand on Southern California Edison would be approximately 22 megawatts (three pump stations, pumps at Pier J, and pumping through the refinery manifold). At 126 pounds of SO_2 emissions per day per megawatt of generation from burning 0.5 percent sulfur oil, Southern California Edison could release 2,294 pounds of SO_2 daily in the air shed. This impact will not occur every day since a considerable portion of the electrical power will be imported from the regional grid. Therefore, the degree of impact is not precisely defined. Moreover, it is not clear how these emissions can be traded off under the new source review process. The impact could be significantly reduced by requiring use of 42-inch pipe (or two tandem 30-inch pipelines) throughout the California segment; greatly reduced friction would reduce power requirements. Other potential emissions by Southern California Edison would be 1,097 lbs/d of NOx, 219 lbs/d of particulates, and 23 lbs/d of hydrocarbons. (Emission factors were taken from Appendix Table A-44 of the California Environmental Impact Report.) The California Air Resources Board recently set a 0.25 percent limit on the sulfur content of oil burned by power plants in the air shed. With this assumed sulfur content the figures are halved.

Effect of oil replacement

After start-up of the Trans-Alaska Pipeline, some of the imported crude oil currently being brought into the Los Angeles Basin would be replaced by North Slope crude oil. The applicant maintains that the 200,000 barrels per day proposed to come over Pier J for local use would displace imported crude oil and thereby effect a beneficial impact on air quality (the more modern Jones Act tankers would displace older tankers with fewer emission control features). To serve as an emissions trade-off (Section 4.1.5, measure 3), the California Air Resources Board requires the applicant to demonstrate that the emissions reduction would be attributable to the Pier J facility, and would be over and above an emissions reduction that would result from movement of the same Alaskan oil over other piers in the absence of the proposed terminal. See Section 3.1.16.5 for a discussion of energy supply and demand; see Appendix A3.1.6.1 for some calculations of emissions levels and trade-off credits for representative fleet mixes. There is a further benefit to development of Pier J as a tanker reception point. Oil entering Pier J, rather that at another berth, would move the impact zone of maximum short-term SO_2 and NOx concentrations from areas surrounding existing port facilities to an area farther out in the harbor. (There is a safety benefit as well [Section 3.1.17].)

Regional and long-term impact of a proven oil replacement would be to reduce total SO_2, hydrocarbon, NOx, and particulate levels in the basin as a result of tanker off-loading. If air pollution agencies cannot obtain an enforceable requirement that all tankers burn low sulfur fuel oil within the harbor prior to start-up of the Pier J terminal, then the applicant can obtain a sulfur dioxide trade-off credit from the locally consumed portion of Alaskan oil carried over Pier J on SOHIO tankers. (See Appendix A3.1.6.1 for typical calculations.) Under optimistic operating conditions, almost all crude oil disembarked at Pier J would be carried on SOHIO tankers. Under the 1980 worst case tanker fleet used in this document (Appendix Table A3.1.6.1-9), 14 percent of the oil would be carried on non-SOHIO tankers burning higher sulfur content fuel in port. This illustrates how assumptions of fleet mix affect the computation of trade-off credits. The fleet that would carry Alaskan oil into San Pedro Bay for local consumption, if the Pier J terminal is not constructed, is still unknown. In the Appendix two fleets are analyzed: Three ARCO 120,000 DWT tankers and one 70,000 DWT tanker; or four SOHIO 80,000 DWT and two non-SOHIO 70,000 DWT tankers, to carry 200,000 bbl/d into San Pedro Bay for local consumption. The all-SOHIO fleet using pier J would result in 242 less tons per year of SO_2 and 26 t/yr less hydrocarbons than the ARCO fleet. The reductions would be 74 t/yr of SO_2 and 46 t/yr less hydrocarbons than from the alternative fleet (which assumes all larger tankers are employed in carrying Alaskan oil to Panama or around Cape Horn). Trade-off credits would be somewhat lower under the assumption that some non-SOHIO tankers would be utilized to carry 700,000 bbl/d through the Pier J terminal.

These calculations are merely illustrative; the actual benefits of oil replacement would depend on many factors yet to be documented, such as actual tanker mix and specific oil contracts after the Prudhoe Bay wellhead oil price is specified.

Impact of the proposed pipeline abandonment

It is anticipated that the abandonment by El Paso Natural Gas Company of a main-line gas pipeline from the Permian Basin in New Mexico to California for conversion to crude oil use would result in about a 1 percent gas supply reduction to El Paso's California customers (El Paso, 1976). Replacement with residual and distillate fuels would then result in increased emissions of sulfur dioxide and particulates in California. The reduced throughput of gas with removal of one gas pipeline follows from the decreased capacity of the transmission system; decreased capacity necessitates additional pumping power which translates into additional natural gas withdrawals from the line as fuel for the compressors. The impact on air quality from natural gas curtailment is expected to be greatest in the first years by reason of the expected continuing decline in supply of Permian Basin gas allocated to California (refer to the discussion of natural gas in Section 3.1.16.5). The estimated amount of curtailment ranges from slightly more than 300 million cubic feet per month in the first two years to less than 200 million in 1981. The BLM contractor, ERT, Inc., analyzed the anticipated effect on ambient air quality and found the realistic worst case deterioration in ambient sulfur dioxide (SO_2) and particulate air quality was about 1 percent. The ERT report (BLM, 1977) is available upon request.

Based on historical deliveries from El Paso to California, ERT found that approximately 50 percent of the curtailment of natural gas would occur in southern California. Southern California Gas Company has indicated that Priority 3 (P-3) customers (includes most small- to medium- sized commercial, government, and industrial customers) would be faced with interruptible service due to curtailment. ERT sought the area most likely to see the largest adverse air quality impact and concluded that this was the industrial region extending from north of Lennox, past Los Angeles Civic Center and bounded on the east by Whittier, La Habra, Anaheim, and Costa Mesa (Figure 2.1.6.2-5). Some assumptions were necessary. The first was that the volume of gas curtailment to P-3 customers in each subregion of Los

Angeles and Orange counties would be proportional to the number of customers in that subregion. This translated into the assumption that about 50 percent of the total Southern California Gas Company curtailment would occur in the primary study area. A worst case was structured on the assumption that 75 percent would occur there.

Gas supply curtailments were translated into necessary alternative fuel volumes (based upon equivalent heat value). SO_2 and particulate impacts were calculated on assumption of either replacement with 0.5 percent sulfur content residual oil (worst case), or with fuel having a reduced sulfur content through inclusion of some distillate oil (0.48 percent sulfur average in 1977, decreasing to 0.44 percent by 1981 as a result of new air quality regulations). The latter case resulted in a significant reduction in particulate emissions; the benefit in reduced SO_2 emissions would be minor. The increased emissions from curtailment to Southern California Gas Company customers in the primary study area were estimated at more than 80 tons per month of SO_2 in 1977, dropping to somewhat above 40 t/mo by 1981. The all residual fuel oil case resulted in an estimate of just over 20 tons per month of particulates in 1977, dropping to slightly above 12 in 1981; the case incorporating distillate gave results of almost 9 and 5 tons per month, respectively.

Emissions were analyzed by area of origin for the four assumed cases (50/75 percent curtailment in the prime area in conjunction with the assumption of all residual/combined fuels). Rollback modeling was used to determine changes in ambient levels; this was done for each year and in each subregion of the primary study area. Rollback modeling requires an estimate of the initial regional emissions levels. The model assumes that, after subtracting out an estimated constant background ambient level, changes in ambient levels are linearly proportional to changes in emissions levels (see Appendix A3.1.6).

The results of the ERT study of the air quality impact of the El Paso abandonment can be stated as follows. In the primary study area taken as a whole, SO_2 emissions levels would rise about 1 percent in the first two years, and particulates would rise 0.43 percent when assuming replacement with only residual oil. On a subregional basis, however, both SO_2 and particulate ambient levels would increase up to 1 percent. Distribution of P-3 customers in the study area only had a significant effect on particulate levels. Lennox, Los Angeles, and Lynwood were identified as likely to experience the largest increases (about one percent) in particulate levels. All other locations studied in the subregional analysis would increase less than one percent. Only Long Beach was found to have a similar 1 percent increase in SO_2 ambient levels; Lennox and Whittier were next with estimated increases of 0.9 percent; and all other subregions would increase less than that.

Total suspended particulates

Particulate emissions resulting from ship pumping in the Long Beach Harbor were calculated for each class of tanker expected to use the Pier J Port facility. Fuel consumption for hoteling and pumping was obtained from SOHIO (Williams Brothers, 1976) and particulate emissions were calculated using emission factors (EPA, 1976) for residual oil burning at full power to represent the 3.0 percent sulfur oil used by non-SOHIO tankers (Appendix A3.1.6.1). Maximum daily emissions for any one tanker would be on the order of 1,600 pounds per day. Total maximum emissions (three ships) are less than 1 percent of daily emissions in 1980 for the entire Los Angeles Air Shed (323 tons -- Table 2.2.6.1-2).

Calculations of impacts using the methods discussed above for SO_2 indicate maximum concentrations near Pier J (at about 3,000 ft) would be, at most, 50 percent of the California 24-hour standard (100 $\mu g/m^3$). Concentrations drop rapidly with distance, so that three tankers simultaneously off-loading would contribute less than 25 percent of the state standard to ambient levels at the beach. Any three tankers would be simultaneously off-loading on about 37 days per year. Since the strong wind speed or other severe meteorological conditions necessary for these maximum concentrations occurs on few days per year, lower contributions to ambient concentrations are expected during most years of the life of the project. See Table 3.1.6.1.2-7 for lower level estimated for more frequently occurring meteorology.

An explosion or fire at the marine terminal or Dominguez Hills would result in considerable concentrations of particulates. An oil spill at sea would have small probability of igniting.

Year 2000

In general, if the proposed project is not altered, and if air quality maintenance planning proceeds on schedule, baseline air quality would improve in subsequent years. If emissions from the project are constant to the year 2000, then they would have a relatively greater effect on air quality in the air shed in year 2000. But, it is likely that additional regulations would be imposed on tankers and terminal facilities with the passage of time. On the contrary, if enforcement and/or regulations are not strong, then deterioration of tankers and storage tanks would lead to higher emissions, along with general deterioration of air quality.

Hydrocarbon and oxidant impacts are expected to decrease by year 2000. This follows from the trend toward tighter regulation and replacement of older tankers with newer tankers having fully segregated ballast, inerting, and other emission controlling systems. Some reduction in nitrogen oxides from stack gases can be expected from new uses of control technology. SO_2 impacts in the Los Angeles Basin between 1980 and 2000 should be minor except in the immediate vicinity of tankers discharging crude oil at Pier J. SO_2 impacts are not expected to change materially during the life of the project unless fuel with lower sulfur content would be substituted.

Particulate impacts are not expected to change significantly during the life of the project unless stricter tanker emission rules are later introduced and enforced. (The same arguments should be applicable to the Valdez terminal.)

3.1.6.2 Pipeline route

3.1.6.2.1 Construction/conversion

Table 3.1.6.2.1-1 presents emission levels during construction along the pipeline route east of the Los Angeles Air Shed, as calculated in Appendix A3.1.6.1. Construction along the route would progress at rates of up to 1 mile per day; consequently, any local impact of pipeline construction would be brief. Construction of each pump station would take approximately six months.

Table 3.1.6.2.1-1

Calculated Construction Phase Emissions Along the Pipeline Route (lbs/d)[a]

SECTION	HC[b]	NOx[b]	SO_2[b]	Particulate Emissions	Fugitive Dust
Desert Center to Ehrenberg	363	2,155	160	105	1,320
Livingston to Eagletail Mountain	548	2,006	135	86	1,100
Jal to Midland	403	1,443	97	62	1,373
Pump stations (per station)	156	428	27	20	200

[a] These calculations are based on estimates of required fuel made in Williams Brothers (1976).

[b] Symbols: HC - hydrocarbons; NOx - nitrogen oxides; SO_2 - sulfur dioxide.

Realistic worst-case calculations for ambient concentrations of air pollutants from these emission levels were determined without specific adverse meteorological input. See Appendix A3.1.6 for details of the methodology.

Oxidant

Emissions of hydrocarbons and nitrogen oxides from construction equipment represent the only significant project-related source of potential oxidant impact during project construction. At least two factors indicate that the oxidant impact from these emissions would be negligible. First, in the absence of other HC sources, the HC/NOx ratio is very low. The excess NO from engine exhausts would tend to react with any ozone. Second, in the rural locations along the pipeline the action of wind and dispersion would greatly decrease HC and NOx concentrations during the three to four hours of reaction time required for oxidant formation, as well as disperse the oxidant itself.

Worst-case analysis indicates a maximum potential 0600 to 0900 (6 a.m. to 9 a.m.) average hydrocarbon concentration of 59 $\mu g/m^3$ at 1640 feet (500 meters) from the Livingston to Eagletail Mountain pipeline construction operation and 123 $\mu g/m^3$ at an equal distance from a pump station construction site. These levels are a considerable fraction of the hydrocarbon standard (160 μ/m^3), but they result from assumption of a steadiness of the wind unusual for the morning time frame and should occur very rarely.

Estimates for ambient levels (1-hour) of nitrogen oxides are comparable to those for the Walnut to Beaumont pipeline construction site and for the pump station in the Los Angeles Air Shed (Section 3.1.6.1.1). These emissions are almost entirely nitric oxide (NO) for which there is no standard. They would diffuse thoroughly before being oxidized to nitrogen dioxide (NO_2) for which there are standards.

Sulfur dioxide

SO_2 emissions in Table 3.1.6.2.1-1 are comparable to those for the Walnut to Beaumont segment in the Los Angeles Air Shed (Table 3.1.6.1.1-1). Maximum 24-hour average ambient levels were estimated to be 12 μg/m³ at 1,640 feet from a pump station construction site, and 7 μg/m³ or less at the same distance from a pipeline construction site. These increments are comparable to those estimated for Los Angeles. They are considerably less than the California standard (105 μg/m³) and are marginal in comparison to the Federal 24-hour standard (365 μg/m³).

Total suspended particulate (TSP)

Particulate emissions resulting from fuel burning by construction equipment and fugitive particulate sources described in Appendix A3.1.6.1 are summarized in Table 3.1.6.2.1-1. Total particulate emissions (from exhaust and dust) do not vary much from pipeline segment to pipeline segment.

At many locations in the Southwest, construction activities may contribute to TSP levels which are currently in excess of the standards (Figure 2.1.6.3-3). Estimates for concentrations resulting from particulate emissions from pipe laying show maximum daily values of up to 60 μg/m³ at 1,640 feet (500 m) from the construction right-of-way, and 36 μg/m³ at a distance of 3,300 feet (1 kilometer). If these particulate levels would pose a hazard to construction workers, resulting in 50 percent dust control through watering, then the increments to ambient levels would be halved. Air quality impact on persons other than workers would be minimal.

Resultant concentrations from each pump station were calculated assuming that the entire 5-acre area of the station is disturbed by construction over a 10-hour work day. Maximum 24-hour concentrations calculated at 1,640 feet (500 m) from the source are approximately 100 μg/m³, and within 3,300 feet (1 kilometer) from the source are 40 μg/m³. These levels are considerable, and under such severe meteorological conditions as assumed here call for watering dust control.

Conversion

The applicant estimates that construction equipment would need 840 gallons of gasoline and 2,100 gallons of diesel fuel to complete the pipeline conversion and tie-in of the El Paso Gas System, and less for the Southern California Gas System (Table 1.2.3.1-4). Using the computational methods described in Appendix A3.1.6, the resultant total emissions are found to be less than the lowest daily emission rates for the pipeline construction segments given in Table 3.1.6.2.1-1. Since this work would be spread out over at least several days, the impacts would be correspondingly lower and therefore insignificant. Since equipment usage would be light, impacts from fugitive dust would also be very small. These fuel consumption estimates are based on the assumption that no major reconstruction of the gas pipeline would be required. If such reconstruction would be necessary in any segment, the impacts would be comparable to those for new pipeline construction.

3.1.6.2.2 Operation

Oxidant

During normal operation, there would be only two potential project-related sources of HC and NOx emissions along the pipeline route, the maintenance vehicles which service the project and the service tanks near the Indio and Redington pump stations. According to the Williams Brothers' environmental impact assessment (1976), there would be five maintenance bases along the pipeline and each was estimated to use 11,856 gallons of gasoline and 5,952 gallons of diesel fuel per year. Using these figures and EPA estimated emission factors for heavy-duty vehicles (EPA, 1976), the average daily emissions of HC and NOx associated with each maintenance center have been calculated and found to be very small. The impacts on ambient oxidant concentrations can be assumed to be correspondingly insignificant.

When the service tank at Indio receives oil as a result of pressure surges, there would be at most 115 lbs/d of hydrocarbon emissions. Atmospheric dilution of these emissions would result in insignificant impacts (compare with the situation at Midland; Section 3.1.6.3.2).

A major oil spill (see Table 3.1.5.2.2-1) from the pipeline anywhere in California, or near Phoenix, Tucson, or Midland would impact air quality for one or more days if a low inversion and moderate sunlight were present. Historical records indicate that this event has a low probability of occurring during the life of the project.

Other vehicular impacts

The applicant-supplied fuel consumption figures for maintenance vehicles translate to SO_2 emissions of approximately 220 pounds per year. Because of the extremely small magnitude of these emissions, the contribution of this source to future ambient SO_2 concentrations would have an insignificant impact. Fuel consumption translates into 250 pounds per year of particulates; the impact would likewise be insignificant.

During operation of the pipeline, emissions are expected from fugitive sources since maintenance vehicles travel some unpaved service roads. It is expected by the nature of the maintenance activities that fugitive dust would be very irregular and would cause negligible impact.

When power failures occur (at most once per year) there would be exhaust emissions from standby generators. These emissions would result in minor adverse impacts, at most.

Emissions from electrical power generation. The project would require approximately 116 megawatts at rated pipeline capacity. The greatest feasible impact on any day would occur if all the required power came from one coal-fired power generating facility. Such a facility would have a capacity of 1,000 megawatts or more. This maximum project load could represent a significant fraction of the plant's excess capacity. The day-to-day impacts would be considerably less since power would normally be drawn from many sources or from a plant considerably larger in capacity. If the full load for the project were assumed to be drawn from a major plant such as the one that was proposed for Kaiparowitz (3,000 megawatt capacity), the actual impact would depend on many factors, including the grade of coal used at the time. Assuming worst grade coal and the plant operating with the same efficiency as proposed for the Kaiparowitz plant, the 116 megawatts for the project would add incremental emissions of 168 lb/hr of SO_2, 45 lb/hr of particulates, and 804 lb/hr of NOx (see Kaiparowitz FES, 1976).

3.1.6.3 Midland and vicinity

3.1.6.3.1 Construction

Oxidant

The only project-related source of HC and NOx emissions during the construction phase would be the heavy duty construction equipment. Average daily emissions from the construction equipment needed to complete the Midland terminal were estimated to be 122 lbs/d of hydrocarbons and 440 lbs/d of nitrogen oxides. Fuel use estimates supplied by the applicant were the basis for these calculations which are detailed in Appendix A3.1.6.1. These emissions are comparable to those for construction of a pump station and less than those for pipeline construction.

Although these hydrocarbon and nitrogen oxides emissions are considerable, no oxidant impact is expected. Oxidant levels, however, during the summer can exceed the Federal standard in the Midland-Odessa area. In the next section (3.1.6.3.2) photochemical modeling for emissions from storage tanks during the operational phase is discussed. No oxidant impact was found when assuming hydrocarbon emissions significantly greater than those that would result from construction.

Sulfur dioxide

Impacts of the proposed Midland terminal on SO_2 levels in the Midland-Odessa area should be negligible. Construction-related emissions and emissions by the vehicles of operational employees should not be significant. Construction-related emissions should total approximately 30 lbs/d (Appendix A3.1.6.1); this level is also comparable to that expected at pump station reconstruction sites. Ambient sulfur dioxide levels from construction would be similarly low.

Total suspended particulates

Construction and operation of the Midland terminal would call for regular watering dust control. Emissions during operation would involve negligible traffic emissions from service vehicles.

The main emission source is the fugitive particulate from construction which has been estimated at 400 pounds for a 10-hour work day. Emissions from construction, calculated in Appendix A3.1.6.1, include particulates from equipment exhausts and from fugitive dust on the site. Maximum daily total emissions from both sources would be approximately 419 lb/d. Calculations using this emission rate by methods discussed in Appendix A3.1.6 show maximum feasible local TSP concentrations of approximately 170 μg/m³ at 1,640 feet (500m) from the construction site and 100 μg/m³ at 3,300 feet (1 kilometer). The Federal primary and Texas 24-hour average TSP standards (260 μg/m³) could be exceeded under frequently occurring meteorological conditions unless dust control watering would be practiced.

3.1.6.3.2 Operation

Oxidant

During normal operation, the only significant project-related source of oxidant precursor emissions would be the four 500,000-barrel oil storage tanks at the Midland terminal. The reactive hydrocarbon vapor losses from these tanks have been calculated by the API method (API, 1962) and are presented in Table 3.1.6.3.2-1.

Table 3.1.6.3.2-1

Calculated Reactive Hydrocarbon Emissions From Oil Storage Tanks at Midland[a]

THROUGHPUT (bbl/d)	Standing Evaporation Loss (lb/d)	Withdrawal Losses (lb/d)	Total Emissions (lb/d)
500,000	1,410	160	1,570

Source: API, 1962.

[a] Assumptions: API calculation method (API, 1962) for 4-500,000 bbl tanks (in Appendix A3.1.6.1).

The details of the calculations are in Appendix A3.1.6.1. The Texas Air Control Board (TACB) has indicated that they calculate an emission rate that is almost three times the figure given in Table 3.1.6.3.2-1.

During the summer, the Federal oxidant standard is sometimes exceeded in the Midland-Odessa area. As a result, the Environmental Protection Agency has declared Air Quality Control Region 218 a Non-Attainment area for oxidant. The Bureau of Land Management requested that its contractor, ERT, Inc., conduct a photochemical analysis of the emissions from the tanks proposed for the Midland, Texas terminal. This modeling is analagous to that performed in the Los Angeles Air Shed. Refer to Appendix A3.1.6 for background on the following description.

Meteorology for 29 August 1976 was chosen for impact analysis. During that month the 1-hour average oxidant standards were exceeded 104 times at Odessa; 29 August was the first day of a 3-day episode. On this day an air parcel was found that originated in the morning at the proposed terminal, migrated south, gradually veered to the west, and finally passed near the air quality monitoring station in Odessa while moving almost due west (refer to, for example, Figure 2.1.6.3-1 for relative locations of Odessa and Midland.)

Measured air quality data and a gridded emission inventory were used to calibrate the ARTSIM photochemical diffusion computer system. The initial background levels of hydrocarbons and nitrogen oxides were adjusted until the model reproduced the ambient oxidant level of 9.1 parts per hundred million (pphm) that was estimated to occur at 1434 at the Odessa monitoring station. (At 1434 the air parcel from Midland was estimated to pass near the monitoring station.) The oxidant level was found to increase as the parcel moved south from the terminal site. Just outside Odessa to the northeast the parcel passed over a complex of petrochemical plants and a refinery; and the oxidant level steadily decreased (nitric oxide emissions combine with oxidant to form nitrogen dioxide and a reduced level of oxidant; ozone, for example, is reduced to oxygen). This decrease in the oxidant level prevailed past the monitoring station.

The model was then rerun with the hydrocarbon emissions from the proposed tanks added to the gridded emissions inventory. The oxidant level along the entire trajectory was raised a fraction of a pphm. At every point, the increase was less than 0.2 pphm. The actual increase was below the effective resolution of the computer modeling system (and about 2 percent of the level in the oxidant standards [8 pphm]). On the basis of this modeling, the oxidant impacts from the proposed tanks are estimated to range from minor to insignificant. If the emissions from the tanks at Midland would be higher than was assumed in the modeling (as indicated by the TACB), then the oxidant level would also be greater. If the TACB estimate is used, then the tanks at Midland would increase oxidant levels at Odessa by about 6 percent of the Federal standard (about 0.5 pphm).

Maintenance

Emissions from vehicles and other equipment for maintenance of terminal facilities would be very small; therefore, no impact is expected. The pipeline would be serviced from the El Paso, Texas maintenance base.

3.1.7 Vegetation

3.1.7.1 Sea Leg and Port of Long Beach

3.1.7.1.1 Conversion/construction

Port of Long Beach area

Dredging and filling. The impacts on vegetation are primarily secondary impacts associated with turbidity resulting from the dredging and filling activities.

There appears to be very little information available addressing dredging and filling impacts on phytoplankton and productivity. A reduction of light penetration within the water column is associated with turbidity. It would be expected that the phytoplankton density and productivity would also undergo reduction with a diminishment of light needed to carry out photosynthesis. But the dredging and filling are also responsible for the release of nutrients, which could stimulate the production of phytoplankton. Phytoplankton densities and productivity have sometimes increased during periods of dredging (Corps of Engineers, 1975). The dredging and filling associated with this project would possibly stimulate an increase in phytoplankton density and productivity within the harbor complex. The specific increases in phytoplankton densities (including areal distribution of increased densities) and productivity would be dependent upon factors such as the season of dredging, extent of nutrient release, and water circulation and quality parameters. It has also been generally indicated by the Allan Hancock Foundation, et al. (1976) that localized occurrence of phytoplankton blooms may occur in association with the dredging activities proposed. Because of the relatively good circulation associated with the proposed dredging and filling areas, it is not expected that any bloom possibly stimulated would extend out of the immediate project area.

Breakwater and trestle. The breakwater would further shelter the seaward face of the Pier J revetment from wave action. This reduction in wave action would probably be responsible for a change in the rocky shore community. A community more typical of the inner harbor would probably develop, with a reduction in algal species diversity.

The breakwater and trestle would provide new habitat for the colonization of various species of algae. It is expected that the seaward face of the breakwater could potentially have a community similar to that existing on the seaward face of the Pier J revetment. Because of a variance in wave exposure, the landward face of the breakwater would probably possess a community lower in species diversity than the seaward face of the breakwater. Eventually, the communities on the landward face of the breakwater and on the Pier J revetment would be similar.

The proposed action would have an insignificant effect on very limited existing terrestrial vegetation. Little vegetation with wildlife food or cover value exists in the Pier J area. Some weedy annual plants would be replaced with ornamental vegetation. The landscaped vegetation should enhance the terrestrial environment, potentially providing more cover and food for wildlife species, mainly birds not associated with water.

Year 2000. The cumulative impacts of the SOHIO project alone would be the loss of about 1.18 million cubic yards of water with the resulting loss of phytoplankton populations and productivity. When considered with the trend for further development in the harbor, such as the general plan and its proposal for extensive fills and resulting reduction in water volume and productivity, the cumulative impacts become more significant. The anticipated landfills will provide new areas available for landscaping with ornamental vegetation and limited natural revegetation.

3.1.7.1.2 Operation

Ocean

The following discussion of potential impacts should be related to Section 3.1.5.1.2, which presents oil spill trajectories; Section 3.1.2.1.2, which discusses impacts of oil on marine ecosystems; and Attachment 2, which identifies the tanker route in relation to certain environmental components.

In addition to the discussions in this section, presented by species and marine environment division, the following summary of impacts resulting from oil spills along the southern California coast is presented from Tetra Tech, Inc. (1977).

South of Point Conception, between Gaviota and Rincon Point, and the leeward side of the Channel Islands, significant quantities of oil might well be grounded within the first 72 hours of a spill. Associated impact percentage probabilities are as follows: Santa Barbara -- 33 in spring, 20 in summer, 29 in autumn, and 43 in winter; Santa Cruz Island -- 23 in spring, 27 in summer, 47 in autumn, and 26 in winter; Anacapa Island -- 29 in spring, 31 in summer, 12 in autumn, and 15 in winter; Port Hueneme-Point Dume -- 17 in spring, 7 in summer, 16 in autumn, and 6 in winter; Santa Monica Bay -- 1 in spring, 1 in summer, 1 in autumn, and 1 in winter.

The biota associated with this region are shown on Maps 10 through 12, Attachment 2. Impacts within the Santa Barbara Channel region may approximate those described for the 1969 Santa Barbara oil spill. There would be essentially complete mortality of Phyllospadix, Porphyra, and Hesperophycus and a 50 percent reduction of algal species diversity in areas impacted by stranded oil. The same prediction should hold for any other rocky intertidal areas impacted to the terminus of the tanker route.

The effects of potential oil spills in certain regions of the Southern California Bight, along the Palos Verdes Peninsula region, in particular, may be difficult to document because of the masking effect of other deleterious or potentially deleterious impacts from miscellaneous causes. The bulk of domestic industrial and thermal effluents discharged into the Southern California Bight are done so within a 31-mile radius of the Los Angeles-Long Beach harbor complex. The input, at least for major waste water disposal systems, has been doubling every 12 to 15 years. Accompanying these discharges are large quantities of toxic and potentially toxic chemicals (DDT, cyanide, mercury, etc.) and other substances which require large quantities of oxygen for degradation (grease, oil, phenolic compounds, etc.). The combination of these elements, when discharged as point sources, might be expected to produce measurable changes in the biota of the receiving waters. Changes have, in fact, been noted. Whether all of the noted changes are attributable to point source pollution is debatable.

The possible impact of domestic sewage outfalls on biota is perhaps best demonstrated by the White's Point outfall, located on the Palos Verdes Peninsula a few miles north of the Los Angeles-Long Beach Harbor complex. Several biotic changes correlate quite well with various waste water parameters. For instance, the decrease in areal extent of Macrocystis kelp beds is quite dramatic.

Phytoplankton. Impacts on the phytoplankton communities along the tanker route would result from tanker discharges and oil spills, operational and accidental. The evidence for possible impacts is derived primarily from laboratory studies, initial visual observations of oil spills, studies after the spills, and a few field experiments. The results and conclusions of the studies in the literature must be kept in context, since the effects of oil spills depend on many conditions.

Galtsoff et al. (1935), Miranov and Lanskaya (1969), and Strand et al. (1971) have reported that the presence of oil in the marine environment generally retards the growth of phytoplankton. Similarly, Spooner (1969) noted that collections following the Torrey Canyon spill showed damage to minute plant cells of the order Prasinaphyceae which float at the surface. In this case, the use of chemical dispersants had complicated the assessment of adverse impacts resulting from the oil on the phytoplankton community (Boesch et al., 1974).

In studies following the Santa Barbara blowout, Oguri and Kanter (1971) found no conclusive evidence of an adverse effect on phytoplankton productivity that could be attributed to the oil spill. They also found that the use of dispersants may result in a marked reduction in productivity and that the longevity of such effects largely depends on currents and the rate of dilution. Because of the lack of adequate background data and the sampling methods used by Oguri and Kanter (1971), Connell (1973) concludes that "the plankton . . . were sampled and reported in such a way as to make it impossible to decide whether there was or was not an effect of oil."

Miranov (1969, as cited by Miranov, 1972) reports that oil concentrations from 0.1 to 1,000 ppm resulted in mortality, and oil concentrations from 0.01 to 1,000 ppm prevented or delayed cell division in phytoplankton. Differences in sensitivity occurred between species. Similar conclusions of a wide range in phytoplankton sensitivity were derived from an extensive literature survey by the Massachusetts Institute of Technology (MIT) Offshore Oil Task Group (1973).

Gordan and Prouse (1973) found that at concentrations below 10 to 30 ppb photosynthesis was stimulated. Concentrations of crude and refined oils from 60 to 200 ppb suppress photosynthesis to varying degrees. No. 2 fuel oil (a petroleum by-product) depresses photosynthesis by 60 percent at concentrations between 100 and 200 ppb.

Crude oil toxicity studies of phytoplankton and other marine vegetation were conducted by Shiels, Goering and Hood (1973) over a one-year period from May, 1971, to June, 1971, in the Port Valdez marine environment. Various indigenous populations of phytoplankton were tested for effects from Prudhoe Bay crude oil in concentrations of 0.003 to 10 ppm, or the expected concentration range from treated ballast-water discharge. The phytoplankton populations showed varied photosynthetic responses to crude oil contamination, probably resulting from a complex interaction of several physical, chemical, and biological factors. A brief summary of some of the results are reported below as taken from Shiels et al. (1973).

1. The concentrations of crude oil in seawater necessary to cause a specific degree of photosynthetic inhibition apparently change seasonally depending on physical and chemical factors and on the species composition and relative abundances. During June, a 50 percent inhibition to phytoplankton photosynthesis occurred at approximately 2.0 ppm crude oil.

2. Crude oil in very low concentrations in seawater stimulated phytoplankton photosynthesis over short incubation periods during December, April, and June.

3. The effects of temperature on oil toxicity to phytoplankton were varied. During March, the oil-treated samples showed decreased phytosynthesis with increasing temperatures above 41°F (5°C); controls indicated an optimum temperature for photosynthesis at about 50°F (10°C). In contrast, during April, the oil-treated samples showed a

maximum rate of photosynthesis at 50 to 59°F (10 to 15°C) compared to a 50°F (10°C) optimum for controls.

4. At high natural-light levels, crude-oil toxicity appeared to be acute. Phytoplankton exposed to about 5.5 ppm crude oil showed a 65 percent reduction in photosynthesis at full light intensity (maximum of 0.89 ly/min), although phytoplankton exposed to the same concentration of crude oil at one-fourth this intensity showed only 20 percent reduction.

5. The relative species composition in a natural phytoplankton population may be altered by crude oil, resulting in a decrease in the abundance of some species and an increase in others. The effect is apparently dependent upon the amount of oil present. During May, Phaeocystis pouchetii cells more than doubled in number after a 48-hour exposure to a crude oil concentration of 10 ppm. In contrast, the number of Thalassiosira nordenskioldii cells was reduced about 75 percent.

Benthic vegetation. Marine benthic flora is generally less sensitive to oil pollution than marine fauna. Nevertheless, there are numerous examples of marine flora being killed or damaged as a result of oil spills and contamination. Most benthic plants are multicellular and are much less susceptible to oil pollution than phytoplankton. However, benthic microflora (e.g., species living between sand grains) are probably comparable to phytoplankton in their susceptibility to oil. Species found in the intertidal and shallow subtidal zones, naturally have the greatest potential to be impacted by oil because the largest quantities of oil would be confined to these zones. Algae are generally more resistant than higher plants. The large brown algae are the least vulnerable because many species are covered by a mucilaginous slime which is not readily penetrated by fresh, thin oil.

The higher the concentrations of low-boiling compounds, unsaturated compounds, aromatics, and acids in oil, the more toxic it is (Baker, 1970). Oil deleteriously affects plants by damaging all cell membranes, reducing transpiration, increasing respiration, reducing photosynthesis, inhibiting translocation and in extreme cases, smothering and burying. Photo-oxidation of crude oil may form organic acids (e.g., cyclohexane carboxylic acid) and peroxides. These substances are harmful to algae (Crafts and Reiber, 1948) and in some cases, may produce more severe impacts than the oil. Most detergents and oil dispersants are more harmful to the plants than the oil.

The two most significant marine spermtatophytes in the project area are eelgrass, _Zosteca marina_, and surf grass, _Phyllospader sp_. The intertidal and shallow subtidal eelgrass communities provide refuge and food for innumerable species, ranging from small invertebrates to fish and birds. Eelgrass is found in most bays and inlets along the entire route from Valdez to Long Beach. Even small quantities of oil can be fatal to _Zostera_. British investigators found that minute amounts of oil weaken the plant and make it susceptible to attacks of a parasitic fungus, _Labyrinthula_. _Phyllospadis_ closely resembles _Zostera_ in appearance, but grows along less protected stretches of coast. It is more resistant to oil than _Zostera_, but would also die if coated with oil.

Chronic low-level pollution would occur in the Prince William Sound and adjacent areas; the amount is unknown. However, if it is sufficient to produce a decline in the _Zostera_ communities, the ecological effects will be profound. For example, dabbling ducks utilize the _Zostera_ communities for feeding and resting as they migrate up and down the Pacific flyway. Any destruction of these vital communities would very adversely impact these birds. Potential impacts to _Zostera_ communities along the remainder of the tanker route are primarily from major spills.

Fucus sp. is a dominant intertidal algae in Prince William Sound and in many locations along the California coast. Spooner (1971) reported that Fucoids in the intertidal and shallow subtidal areas were overweighted by thick oil from the Arrow spill in Nova Scotia, and destroyed, along with the other algae. After the Santa Barbara blowout, the intertidal algae, Hesperophycus harveyanun, became so heavily encrusted with oil that the plants were broken off by the waves, leaving barren areas (California Department of Fish and Game, 1969). Diaz-Piferrer reported that Puerto Rican shores were denuded of algae after the Argea Prima spill.

It is obvious from these reports that large spills are devastating to algae. What the long-term effects are is uncertain. Nicholson and Cimberg (1971) compared the flora of southern California beaches, after the 1969 Santa Barbara blowout, with flora listed in surveys made 12 to 15 years earlier. They found an average reduction of 63 percent in the number of species. Greatest losses were observed to be red algae. The reduction in species is difficult to relate directly to the Santa Barbara blowout. Natural fluctuations as well as domestic sewage, chronic low-level oil pollution, and other factors may have caused the decline.

Relatively little experimental work has been done regarding the effects of oil upon marine vegetation. Shiels, Goering and Hood (1973) studied the effects of Prudhoe Bay crude oil on selected flora in Port Valdez between May, 1971 and June, 1972.

The following seaweed species were studied:

Chlorophyta
- Cladophora stimpsonii (Harvey, 1859)
- Enteromorpha intestinalis (L.) (Link, 1820)
- Ulva fenestrata (Postels and Ruprecht, 1840)

Phaeophyta

Alaria teniafolia (Setchell, in Collins, Holden and Setchell, 1901)
Costaria costata (Turner) (Saunders, 1895)
Fucus distichus (Linnaeus, 1753)
Laminaria saccharina (L.) (Lamourous, 1813)

Rhodophyta

Rhodymenia palmata (L.) (Greville, 1830)
Halosaccion glandiforme (Gmelin) (Ruprecht, 1851)

Shiels, Goering, and Hood made the following comments about the effect of oil on algae:

> Photosynthetic response to oil-treated seawater was different for each species; some showed inhibition at 7 ppm, while others appeared unaffected. Cladophora stimpsonii indicated a 65 percent photosynthetic reduction at 7 ppm, while Costaria costata appeared to be unaffected at the same concentration. Photosynthetic stimulation by crude oil was suggested for some species; at 0.7 ppm Ulva fenestrata had a rate nearly twice that of the control.
>
> Discussion: Literature on the effects of petroleum products on seaweeds is primarily from studies of economically important species. In tests with the giant brown algae, Macrocystis pyrifera, Clendenning (1959) found that diesel oil, emulsified in seawater to give a one percent by volume oil concentration, reduced photosynthetic capacity 25 percent after 24 hours and 100 percent after 72 hours of exposure. If the kelp were exposed to a diesel oil emulsion for a period of six hours, irreversible damage was done, presumably because at least that much time was required for penetration of the oil into the cytoplasmic membrane (Van Overbeek and Blondeau, 1954). Since no experiments in this study were conducted for periods that long, it is not likely that the effects were thoroughly observed.
>
> The green algae, Enteromorpha intestinalis is considered a very hardy species, being both eurythermal and euryhaline. Gross photosynthesis was greatly reduced, however, when the plant was exposed to 10 ppm crude oil for four hours.
>
> Seaweed toxicity experiments conducted in this study were limited by the length of exposure time (two-four hours) and the absence of information on the toxic effects of oil to reproductive forms of the algae such as gametes and zoopores. Since the protective covering of mucilage typical of nature plants is often absent in reproductive forms, severe damage to a seaweed population could occur if seawater were polluted by oil during the time of year when gametes are released.

Many species of algae are annuals. The giant kelp, Nereocystis sp., for example, which forms beds or forests from central California to the Gulf of Alaska, is almost completely replaced every year. As mentioned above, the reproductive stages of many species of algae lack the mucilagenous covering which helps provide brief protection against oil. Without this covering, the reproductive forms are very vulnerable. Templeton (1972) states that oiled annuals rarely recover. If oil were to destroy large numbers of the reproductive stages, the annual algae in an area could be virtually wiped out. Loss of a kelp bed would have a very pronounced impact upon other species of algae, invertebrates, fish, and marine mammals.

In summary, marine algae have been shown to be vulnerable to oil pollution. Because algae are critically important in producing oxygen and food, providing shelter, substrate, and so on, any deleterious impacts upon them would have serious and widespread consequences throughout the marine environment.

Bays and estuaries

The plants of bays and estuaries are affected by oil in the same ways ocean plants are affected -- cell membranes are damaged, photosynthesis, transpiration, and translocation are inhibited and reduced, respiration is increased and in extreme cases smothering and burying occurs. The toxicity of oil depends upon its chemical characteristics (see above).

Studies of salt marsh vegetation in Milford Haven (Cowell, 1971) have shown that it may be damaged by crude oil. On the Brittany coast, Puccinellia maritima, one of the chief types of European salt-marsh grass, and other species of marsh grass were killed by the Torrey Canyon oil even after it had been weathered at sea for at least seven days (McCaull, 1969). Another author (Smith, 1968) believed this oil had been at sea 24 days, not 7. He also stated it was free of detergent. It is apparent that even weathered oil severely impacts salt marsh vegetation.

Baker (1971) sprayed salt marshes in southwest Wales with fresh Kuwait crude oil at different times of the year. Results indicated that a light pollution with crude caused little long-term damage to most salt marsh plants, whatever time of the year pollution occurred, although the most damage occurred in warm months. Oiled leaves died, but perennial plants recovered well with new growth. Annual plants were severely reduced in numbers because they could not recover by new growth before fall. Seed production of annuals was inhibited for one season.

Baker (1971a,b) further stated that heavy pollution is much more damaging because large volumes of oil can soak into the bases of plants and kill their growing points. Penetration of oil into the substrate has direct effects by spreading around root systems and reducing normal bacterial activity or oxygen content. This bacterial activity is indirectly affected by smothering the shoots of plants such as Spartina which pass oxygen into the soil via their roots. Baker demonstrated a great reduction in this oxygen diffusion when the leaves were painted with oil. The roots of healthy Spartina are surrounded by brown, oxidized mud; after repeated oiling of the plants, this becomes blackened and anaerobic. Bacterial degradation of oil is largely aerobic, and under such reduced conditions, may be very much slowed down. These changes would profoundly affect associated fauna.

Mackin (as cited in Stone, 1972) studied the effects of crude oil on a number of Louisiana marsh grasses. The species included salt grass, Distichilus spicata; cordgrass, Spartina alterniflora; and Bates grass, Batis sp. These are the dominant species in the fresh and brackish marshes. Mackin's data strongly imply that long-term exposure to petroleum at relatively high concentrations is quite lethal, and that immediate and rapid cleanup is therefore critical and essential (Stone, 1972).

Boesch (1973) notes that while ". . . more study and quantification are required, it seems likely that petroleum hydrocarbons, even those not soluble enough to be directly lethal, may inhibit photosynthesis for a short time and under the proper conditions." The proper conditions refer in part to exposure of plant organisms to petroleum hydrocarbons at concentrations greater than 50 to 100 mg/l.

The West Falmouth spill (fuel oil) provided a unique opportunity for a study of the immediate and long-term effects of an oil spill on an area where the previously existing environmental base was well known (Blummer et al., 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer et al., 1970b; Sanders et al., 1972). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer et al. (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be the source of a chronic pollution problem near that spill.

A recent study by Mitchell et al. (1975) conducted four to five years after the West Falmouth spill observed that certain species, such as oysters, mussels, and barnacles were more tolerant than others. The sediment samples of marsh, basin, and offshore locations still contained weathered petroleum hydrocarbons. The authors noted that the number of benthic species was lower for the marsh and offshore stations than for control stations unaffected by the spill. This indicates a decrease in species diversity for the affected areas. Mitchell, et al. (1975) concluded that the area was recovering, but the effects of the spill were still evident four to five years after the accident. Although this spill involved fuel oil, the results of the study are informative about the persistence of weathered petroleum hydrocarbons in bottom sediments.

A serious problem for bays, estuaries or marshes is that oil entering and entrapped in these habitats can remain in the bottom sediments, especially in mud or tidal flats, for several years. This results in a periodic release of hydrocarbons to the environment. Such persistence in the bottom sediments has been reported off West Falmouth by Blumer and his coworkers for up to four or five years after an oil spill had occurred. Similar results occurred when the tanker Arrow spilled 108,000 barrels of Bunker C oil in Chedabucto Bay. Table 3.1.2.1.2-1 in Section 3.1.2.1.2 gives persistence times for oil in a variety of marine environments. It is obvious that oil would remain in mud flats for the longest period. Oil on a narrow intertidal beach with heavy surf would not remain as long as oil on wide, shallow mud or sand flat. Here the oil can be trapped in the sediments and not be stirred up by violent wave action. Since degradation of hydrocarbons is mostly an aerobic process, the anaerobic conditions that result as oil works into the sediments and is covered by detritus, prolong the breakdown process. Therefore, complete biological recovery in a restricted circulation estuary or lagoon, such as Mugu Lagoon, California could take at least 4 to well over 10 years for complete biological recovery from a massive oil spill that entered the area.

Bays and estuaries in Alaska (including Orca Inlet, Hawkins Island Cut Off, Ibeck Creek, Glacier River, Copper River, and Bering River) and California (including Bodega Bay, Pescadero Marsh, Elkhorn Slough, Morro Bay, Mugu Lagoon, and Anaheim Bay) could be severely impacted by an oil spill and by chronic low-level pollution. Scores of other bays and estuaries, too numerous to mention, could also be impacted. As discussed in Section 3.1.2.12 the effects of a major spill in one of these areas could last a minimum of 4 years (salt marsh habitat) or a minimum of 10 years (worm and clam flats). Maximum effects could easily last three or four times this long. With the potential for such long-term impacts, every effort should be made to protect these critically important ecosystems, including the maintenance of oil containment equipment on location at the most important bays and estuaries (see Chapter 4).

Port of Long Beach area

Introduction. At present, it is not possible to relate existing toxicological laboratory and field data quantitatively to Long Beach Harbor species because few of those species have been tested with Prudhoe Bay crude oil. Other oil studies cannot be directly correlated to this project because of different oil types, dosages, oceanographic conditions, and biological environments.

Certain factors determine the actual impacts on biota from a spill of Prudhoe Bay crude oil in Los Angeles-Long Beach Harbors. The oil type may be the most important factor. Prudhoe Bay crude oil is high in both naphthenic and aromatic compounds and is highly toxic. The aromatic hydrocarbons contain low-boiling-point fractions (i.e., benzene, toluene, and xylene) and high-boiling-point fractions (naphthalene, anthracene). The low-boiling-point aromatics are more water soluble and the high-boiling-point aromatics are less water soluble. The high-boiling-point fractions are slow but severe poisons and seem more toxic to fish (Blumer, 1972).

The oil dosage is also important. Spill impacts in the harbor, where the oil is confined, would be greater for a given volume/type of oil than if released in relatively open areas, such as Santa Barbara Channel. The time of year determines the degree of reproduction disruption. Because most marine organisms reproduce during the spring months, a spill during this period generally has the greatest impact on marine populations and communities. Oceanographic conditions, such as currents and wave action, influence dosages of a spill. Through dilution and evaporation, storms increase wave action and thus dilute toxic fractions. A high concentration of suspended solids from storm runoff would absorb the oil and sink it, which in turn reduces the impact on intertidal organisms but is detrimental to benthic organisms (National Academy of Sciences, 1975).

Some general statements can be made. Auke Bay laboratory bioassays confirmed that Prudhoe Bay crude oil is highly toxic to marine organisms (Evans, 1973). The lighter and aromatic fractions of oil tend to be more toxic to organisms (Evans and Rice, 1974). Those fractions are available in Prudhoe Bay crude oil. (See Table 3.1.7.1.2-1.) Oil can remain in bottom sediments, resulting in periodic releases of hydrocarbons into the environment. Hydrocarbons can destroy marine organisms and/or enter the food chain (Evans and Rice, 1974; U.S. Dept. of the Interior, 1976). The general consensus of the literature is that the larval and juvenile forms of animals as well as molting stages of benthic invertebrates are most vulnerable to oil toxicity (Evans, 1973).

Table 3.1.7.1.2-1

Composition of North Slope Crude Oil

FRACTION/ BOILING RANGE	% Vol. in crude	Volume % Composition		
		Paraffins	Aromatics	Naphthenes
Naphtha	20.0	9.00	3.00	8.00
Kerosene	9.4	3.01	2.35	4.04
Gas oil	12.6	4.03	3.91	4.66
Gas oil and heavy distillates	36.9	6.27	15.13	15.50
Bottoms	21.6	2.16	10.80	8.64
Total	100.5	24.47	35.19	40.84

Source: Robert Brown Associates, Analysis of North Slope Crude Oil, 1976.

Terms used in text are defined as follows:

1. Direct lethal toxicity -- Hydrocarbon interference with cellular and subcellular processes, especially membrane activities, leading directly to organism death.

2. Sublethal toxicity -- Interference with cellular and physiological processes; does not include lethal effects. The most important effects are from behavior disruption (feeding and reproduction).

3. Coating -- Primary effects are smothering and mechanical interference with activities (movement and feeding).

4. Hydrocarbon incorporation -- Tainting of edible organisms with hydrocarbons.

5. Habitat changes -- Alterations in the physical or chemical environment that result in significant shifts in species composition.

The following information concerning past effects of crude oil is presented to provide a general insight on possible adverse effects that spills of Prudhoe Bay crude oil may have on organisms and communities associated with the Port of Long Beach area.

As noted earlier, marine vegetation species differ considerably in their sensitivity to crude oil, and difficulty arises in determining lethal and sublethal effects. Investigations of several past oil spills have revealed that oil deleteriously affects marine vegetation by damaging cell membranes, reducing transpiration, increasing respiration, inhibiting translocation, and reducing photosynthesis (Chan, 1975; Nelson-Smith, 1973). Chronic long-term oil pollution impacts on marine vegetation are unknown (Shiels et al., 1973). Also, as noted, phytoplankton near the surface would be destroyed or reduced during an oil spill. Phytoplankton within the water column would be inhibited because of decreased photosynthesis from lowered light levels, lower cell division rates, and damage to cell membranes (Boesch, 1973). Maximum impact from oil pollution occurs during late spring and early fall growing seasons.

The disruption of photosynthesis and development of algae communities through sublethal toxicities, coating, and habitat changes is of primary concern. Studies by Kopperdahl, et al. (1975) show that algae growth is inhibited by both physical and chemical means. Studies have shown oil pollution inhibits photosynthesis in algae species Cladophora, Ulva, and

Laminaria (Shiels et al., 1973). Some studies on Ulva, Latuca, and Gratelupia dichtoma suggest that oil inhibits biosynthesis of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) and modifies the degree of polymerization of the DNA (Davavin et al., 1975). Oil and its emulsions coat and destroy marine algae. Surviving organisms' photosynthesis is inhibited by the coating. When Laminariales are weighted with oil, they are easily torn loose and they subsequently die (Anderson and Bissell, 1975).

An oil slick may reduce light penetration up to 90 percent, thus decreasing phytoplankton productivity. Oxygen exchange across the water surface is also greatly reduced under an oil slick; this, in turn, reduces the phytoplankton populations (Nelson-Smith, 1973). The oil may have direct chemical and mechanical effects as well as indirect effects on nutrition and behavior (Nelson-Smith, 1973). Thin films of oil are not lethal to individuals but may interfere with diatom reproduction (Zobell, 1963). Depressed growth rates for diatom cultures were reported from exposure to crude oil pollution. Phytoplankton can absorb, but apparently do not transfer, petroleum hydrocarbons inside the cell; instead, such hydrocarbons are passed directly through (Nelson-Smith, 1973). Little bioaccumulation of hydrocarbons occurs in phytoplankton (Lytle, 1975).

Professors at the University of California, Santa Barbara, reported heavy biological damage to intertidal surf-grass and continued damage to Phyllospadix sp. even 16 months after the Santa Barbara blowout (Marx, 1971). Degeneration of Thallassia beds continued several months after a crude oil spill in Guayanilla Harbor, Puerto Rico (Nelson-Smith, 1973). This spill extensively damaged intertidal and sublittoral algae. Another spill of crude oil in San Juan Harbor destroyed algae although subsequent recovery occurred.

Terrestrial vegetation. Operation and maintenance of the project would have an insignificant impact on Long Beach Harbor terrestrial vegetation.

Accidental oil pollution of port terrestrial areas would affect very little nonlandscaped vegetation. Any landscaped plants affected by project operations or oil spills could be replanted following appropriate soil treatment procedures.

Year 2000. Incremental and catastrophic oil spill from future operations will further stress the phytoplankton and algal populations throughout the harbor, which could result in reduced productivities.

3.1.7.2 Pipeline route

3.1.7.2.1 Conversion/construction/operation

The site preparation and construction of the proposed pipeline and ancillary facilities would destroy plants within the construction zone. This zone requires the clearing of land surfaces for the pipeline construction corridor, pump stations, permanent access roads, permanent power transmission line roads, maintenance bases, temporary access roads, and construction camps and borrow sites.

There are six regions from California to Texas that would have the vegetation impacted as a result of pipeline construction: (1) California Coastal Biome, from Pier J in Long Beach to Beaumont, California; (2) California Colorado Desert Biome, from Ford Dry Lake to the Colorado River; (3) the Colorado River; (4) Yuman Desert Biome, from the Colorado River to Ehrenberg, and a section between the Livingston Pump Station and the Eagletail Mountains; (5) Trans-Pecos Desert Scrub Biome, and the Guadalupe Escarpment; and (6) Short-Grass Prairie Biome, from Jal, New Mexico, to Midland, Texas.

California Coastal Biome

The pipeline right-of-way between Pier J and Dominguez Hills terminal extends 12 miles with a 40-foot-wide construction zone constituting approximately 58.2 acres. The construction impact would be negligible there because the vegetation in this area consists of a sparse cover of annual weedy species.

Dominguez Hills terminal. This site covers approximately 69 acres and has already been heavily impacted by excavation activity; consequently, the impact on the sparse vegetation there would be nonexistent.

In Los Angeles County, elements of the riparian woodland vegetation would be impacted along the banks of the San Gabriel River; construction would impact a number of individual trees such as willow, black walnut, white alder, and mulefat, a willowlike shrub. Between the river banks, proposed pipeline construction would cross about .2 mile of dry riverbed consisting of pampas grass and an occasional willow. The 100-foot-wide construction right-of-way would impact about 2.2 acres of this dry riverbed vegetation. The 12-foot-wide maintenance road right-of-way would require the permanent removal of .2 acre. Revegetation would be allowed in the construction zone. Pipeline repairs, if necessary, would be confined to the standard right-of-way of 50 feet which could affect 1.1 acres of the stream bed vegetation.

Puente Hills. This area, south of Pomona, is the only annual California grassland area undisturbed by agriculture and urban development along the pipeline route. The construction corridor through this region would be 4.3 miles long and 100 feet wide, thus requiring the removal of about 52 acres of annual grassland with species in the following genera: brome grass, wild oats, and fescue, The carrying capacity is about 2.5 acres per animal unit month (AUM). There would be an estimated 21 AUMs lost from construction for the first year or two. Also, 2.5 AUMs would be lost per year for the life of the project during to the operational phase which would require a 12-foot wide maintenance road. Should the standard right-of-way be needed for pipeline repairs, 26 acres and 10.5 AUMs could be temporarily lost. Reinvasion of predominant weedy annuals along with a minor component of grasses should occur within one to two years over this area except for the 12-foot-wide maintenance road. Where the gradient exceeds 15 percent on a slope of a few hundred feet, vegetation rehabilitation might be impeded by rill and gullie development from surface runoff.

A further impedance of revegetation would occur from soil-profile mixing which causes a loss of soil quality and fertility. A concomitant loss in plant density, vigor, and change in the plant community composition, compared to the preconstruction habitat, would follow. Soil mixing would occur in similar consequences in other regions where pipeline construction would take place. The specific areas in the Puente Hills which would experience a serious impact would be those in which steep topographic gradient and soil-profile mixing occur together. Here, the development of a protective plant cover would thus be inhibited.

San Timoteo Canyon. The pipeline construction would be buried under the creek where it crosses the south end of San Timoteo Canyon, impacting about 50 feet of riparian vegetation. Construction at the crossing would require the removal of about one-tenth an acre of riparian woodland vegetation. Accidental fire from construction activities within the fire-prone San Timoteo Canyon could potentially impact the transition scrub, coastal sage scrub, and chaparral plant communities (Table 2.1.7.2-1) bordering the canyon.

Colorado Desert Biome

The second major pipeline construction corridor for the proposed pipeline is proposed to begin at Ford Dry Lake and cross the creosote bush-bur sage plant community. Pump stations at Indio and Desert Center also are proposed to be within this desert.

Indio Pump Station. This structure would require the removal of 10 acres of creosote bush-bur sage plant community. The dominant plants here are creosote bush and bur sage; other species are noted in the gravelly bajada habitat described in Chapter 2. There is no grazing allotment in this biome. There would be no revegetation within any of the pump stations for the life of the project. The transmission line servicing this facility would utilize the existing roads.

Desert Center Pump Station. Construction of the station would require the removal of 10 acres of disturbed creosote bush-bur sage vegetation; other species are noted in the bajada habitat which is described in Chapter 2. The transmission line road servicing this facility would require a construction corridor 11.8 miles long by 12 feet wide. This would result in the removal of about 17.2 acres of creosote bush-bur sage vegetation, since it occurs on the sandy bajada habitat, in addition to some wash woodland vegetation.

Pipeline construction. The proposed pipeline construction corridor would be 25 miles long and 100 feet wide as it traverses national resource land from Ford Dry Lake to the agricultural area in the Palo Verde Valley. This would require the removal of about 303 acres of predominantly creosote bush-bur sage vegetation occurring on a sandy bajada habitat, along with some wash woodland. Within the construction zone, 20 miles is classified as open to off-road vehicle travel; vegetation there would continue to be impacted even if the pipeline were not built. Soil profile mixing from construction would probably have a long-term impact on productivity. With an annual rainfall of 5 inches or less, some perennial shrub revegetation cover would take 10 years to develop within that corridor other than the portion occupied by the maintenance road. Long-term vegetation recovery and productivity is discussed in Chapter 6. Climatic factors, such as high wind velocities in spring and sporadic but intense summer thunderstorms, combined with the slow vegetation recovery time, would result in localized impacts along this segment of pipeline construction.

Yuman Desert Biome

East of the Colorado River in Arizona there would be two new pipeline construction segments (Figure 2.1.7.2-3), one near Ehrenberg and another crossing a part of the Kofa Game Range. Pump stations would be situated at Ehrenberg, Livingston, and Gila, and would impact the natural vegetation.

A small riparian plant community of cottonwood-salt cedar, which is located adjacent to the Colorado River, would be denuded. The riparian vegetation stand is dominated by salt cedar, *Tamarix* sp. and four-winged saltbush. Fremont cottonwood is scattered along the periphery of this stand. The riparian vegetation along the Colorado River should recover quickly from disturbance.

Pipeline construction. From the Colorado River to the Ehrenberg Pump Station (Figure 2.1.7.2-3), new pipeline construction would cover a total distance of 5.6 miles and a width of 100 feet. One-quarter mile or 3 acres of agricultural land adjacent to the Colorado River would be impacted. About 5.4 miles or 63 acres, consisting predominantly of creosote bush and bur sage would be impacted. This plant community is associated mainly with desert pavement with very sparse vegetation in this area as discussed in Chapter 2. Arroyo bottoms which traverse this plant community contain some small trees, shrubs, and scattered saguaro. This area is classified as ephemeral seasonal rangeland, a classification which does not have a carrying capacity in animal unit months. The number of cattle carried here is determined by the seasonal productivity of annual plants. When rainfall occurs in sufficient amount to produce ephemeral forage, livestock are licensed on the range. This generally occurs less than 5 of any 10 years.

Ehrenberg Pump Station. Construction of the station would require the removal of 10 acres of the creosote bush-bur sage vegetation stand in the desert pavement area. The power-line road for the Ehrenberg station would parallel the pipeline and there probably would not be a further impact to the vegetation. There has been no grazing from the Colorado River to Ehrenberg for the last 10 to 12 years.

Livingston Pump Station. This facility would require the removal of 10 acres of the creosote bush-desert ironwood vegetation stand (Figure 2.1.7.2-3); other significant species are bur sage and little-leaf palo verde. The site is just off the western border of the Kofa Game Range. The carrying capacity for grazing is dependent on ephemeral annual forage which fluctuates with rainfall from year to year.

Pipeline construction -- Kofa Game Range. New pipeline construction, between the Livingston Pump Station and the Eagletail Mountains area would cross a portion of the Kofa Game Range. From the Livingston Pump Station east for 8.8 miles into the Kofa Game Range, there would be no new construction. However, from this point eastward for the next 34.2 miles the new construction corridor would occupy an additional 40-foot-width adjacent to the already existing pipeline right-of-way. The corridor would require the removal of a total of 166 acres through four different vegetation stands (Figure 2.1.7.2-3). Range carrying capacity is very low, varying between 53 acres per AUM for creosote bush-bur sage and 27 acres per AUM for the creosote bush-desert ironwood vegetation stand. There would be a total loss of 5 AUMs from the construction phase. Within this 34.2-mile construction zone, the Kofa Game Range would account for about 15 miles, 73 acres of combined palo verde-creosote bush and creosote bush-bur sage vegetation stands, and almost 3 AUMs lost.

Gila Pump Station. Construction of the station would require the removal of 10 acres of vegetation in the creosote bush-bur sage plant community (Lowe and Brown, 1973). The range carrying capacity is about 53 acres per AUM. Construction would take 10 acres of rangeland out of production and result in a loss of about .2 AUM per year for the life of the project. The power line would be adjacent to the pipeline, and there probably would not be an additional impact.

Casa Grande Pump Station. This facility would require the removal of 10 acres of agricultural land for the duration of this project.

Arizona Upland Desert Biome

There is no new pipeline construction within this biome; however, three pump station sites would be required.

Coolidge Pump Station. This facility would require removal of the 10 acres of the creosote bush-bur sage vegetation discussed in Chapter 2. The grazing capacity is about 27 acres per AUM. This facility would result in a loss of under one-half AUM per year for the life of the project.

Black Mountain Pump Station. Station construction would denude 10 acres within a grama grass-tobosa grass vegetation stand. This area contains knolls dominated by grasses including tobosa, black grama, and a number of three-awn species. Carrying capacity is estimated at 11 acres per AUMs and construction would result in a loss of about 1 AUM lost for each year of the project. The power-line road would be 8.6 miles long by 12 feet wide and would remove 12.5 acres of creosote bush-bur sage and grama-tobosa grass vegetation stands. Impact from the power-line road would result in about a 1 AUM lost to grazing for each year of the project.

Oracle Natural Gas Compressor Station. This compressor station would be removed and a potentially beneficial impact could occur since this area would be allowed to undergo natural revegetation. The vegetation of the contiguous area consists of a gram-tobosa grass vegetation stand. Correspondingly, removal off this site potentially would result in a 1 AUM gain to grazing per year. However, revegetation following disturbance is slow. Also, the productivity of the disturbed site may not reach the existing productivity of the adjacent undisturbed vegetation, as noted under the Desert Grassland Biome discussed in Chapter 6.

Redington Pump Station. Construction would remove 10 acres from the grama grass-yucca vegetation stand. The carrying capacity of the area is about 8 acres per AUM. Construction would result in a loss of 1 AUM per year. The power-line road would be 5 miles long by 12 feet wide and would remove a total of 7.3 acres of grama grass-yucca and creosote bush-bur sage vegetation stands. The estimated loss to grazing at the site is less than 1 AUM per year for the project life.

Desert Grassland Biome

Bowie Natural Gas Compressor Station. This compressor station would be removed and a potentially beneficial impact could result as natural revegetation would be allowed to occur on this site. The surrounding area consists of a mesquite grassland vegetation stand. Removal of the station would permit a potential 1 AUM gain to grazing per year. However, revegetation following disturbance is slow. As noted in the discussion of Oracle Compressor Station, the productivity of the disturbed site may not reach the existing productivity of the adjacent undisturbed vegetation.

Only one new construction site would exist within this biome.

Cochise Pump Station. This facility would require the removal of 10 acres of mesquite grassland which has a carrying capacity of about 8 acres per AUM. Impact at the site would result in the loss of an estimated 1 AUM per year for the life of the project. The pump station requires a power-line road 30 miles long and 12 feet wide which would force the removal of 44 acres of mesquite grassland. Carrying capacity for the road corridor is about 9 acres per AUMs. Impact on this site would result in an estimated 5 AUM loss per year for the life of the project.

Chihuahuan Desert Biome

Lordsburg Pump Station. This station would occupy 10 acres of previously disturbed creosote bush with a carrying capacity of about 27 acres per AUM. Construction would result in a loss of less than one-half AUM per year. The power-line road would remove the vegetation in a strip 6 miles long by 12 feet wide for a total of almost 9 acres of creosote bush. This impact would result in a loss of less than one-half AUM per year.

Deming Pump Station. Construction would require the removal of 10 acres of developed agricultural land.

Anthony Pump Station. Development would be located on 10 acres of land immediately adjacent to the Rio Grande agricultural valley. The natural vegetation probably consisted of a Dalea dune vegetation stand which has since been disturbed. An undisturbed site has a carrying capacity of about 35 acres per AUM; however, the AUM loss for the site would be miniscule.

El Paso Pump Station. Ten acres of creosote bush vegetation would be removed which has a carrying capacity of about 20 acres per AUM. Construction would result in a loss of one-half AUM per year. The power-line road is 10 miles long by 12 feet wide and would remove over 14 acres of creosote bush. The loss would amount to almost 1 AUM per year.

Trans-Pecos Desert Scrub Biome

Guadalupe Pump Station. Construction would remove 10 acres of creosote bush vegetation stand with a loss of about one-half AUM per year. The power line would parallel the pipeline and there probably would be no additional impact.

Pecos River Pump Station. Construction would result in the removal of 10 acres of a creosote bush vegetation stand with a loss of about one-half AUM per year. The power-line road would be 30 miles long by 12 feet wide and would cross 4 miles of creosote bush growth (6 acres), 20 miles of mesquite growth (30 acres), and 6 miles of mixed vegetation (8 acres). Carrying capacity of the area is about 12 acres per AUM. This impact would result in a loss of about 4 AUMs per year.

Short-Grass Prairie Biome

The Jal to Midland pipeline would be new construction that would cover a distance of 73.1 miles with an 100-foot width resulting in a construction corridor disturbance of about 886 acres. There would be 70.5 miles (855 acres) of natural vegetation disturbance (Figure 2.1.7.2-6). Vegetation stands that would be disrupted during pipeline construction consist of perennial short-grass prairie (31.2 miles, 378 acres), shin-oak mesquite (21 miles, 255 acres), mesquite dune (4.8 miles, 58 acres), and mesquite-snakeweed (13.5 miles, 164 acres) (Figure 2.1.7.2-6). The carrying capacity of these four vegetation stands respectively is 5 acres/AUM, 6 acres/AUM, 5 acres/AUM and 8 acres/AUM. Within these vegetation stands, the loss of AUMs from the construction phase would be as follows: perennial short-grass prairie, 76 AUMs; shin-oak mesquite 43 AUMs; mesquite dune, 12 AUMs; mesquite-snakeweed, 21 AUMs. The total loss from construction would be 152 AUMs.

The impact from the operational phase requires a 12-foot-wide maintenance road and would cause the following annual loss in AUMs: perennial short grass prairie (9 AUMs), shin-oak mesquite (5 AUMs), mesquite dune (>1 AUMs), and mesquite snakeweed (<3 AUMs). The total loss from the operational phase would be 18 AUMs per year for the life of the project.

Natural revegetation would take from 5 to 10 years and would depend upon the following factors: seed source of the contiguous rangeland, good rainfall, and soil quality following the drastic soil disruption from soil profile mixing. If a clay subsoil is encountered, the soil mixing would improve the soil and enhance revegetation. If a shallow topsoil overlies a rocky area or a poor quality subsoil, then revegetation would be very slow (James Crumley, Odessa (TX) SCS, 1976: tele. comm.). Part of the proposed pipeline construction corridor would be impacted by agriculture and industry near Midland (Figure 2.1.7.2-6). Further discussion on the productivity of this biome appears in Chapter 6.

3.1.7.3 Threatened and Endangered plants

Endangered and Threatened plant species lists were reviewed from the Federal Government and the state of California.

Construction/operation

A number of Threatened and Endangered plant species are potentially vulnerable to impacts from the proposed pipeline construction. Impacts to individual plants of these species are discussed as their potential habitats relate to new proposed construction sites.

During the operational phase, individual plants of a species could be destroyed if they occupy areas adjacent to the pipeline corridor and if an oil spill occurred there. At present, the only known specific location where this probability exists is in New Mexico.

3.1.7.3.1 Federally Endangered and Threatened species

The primary intention of the U.S. Fish and Wildlife Service under the Endangered Species Act of 1973 is to protect, maintain, and restore Endangered and Threatened species and the habitat they depend upon, to the extent that such species will no longer be Endangered or Threatened. The Act recognizes that the destruction or modification of a species' habitat can result in that species' extinction. Consequently, the primary objective is to protect these species within their natural habitats.

Accordingly, the U.S. Fish and Wildlife Service is gathering information to assist in delineating spatial environments, including geographical boundaries, when possible, considered to be "critical habitat" for Endangered and Threatened species (Federal Register, 40 FR 17765-17765). At the present time, there have been no "critical habitat" areas designated for the species discussed along the proposed pipeline route.

The Fish and Wildlife Service emphasizes that there can be certain actions that may not be detrimental to "critical habitat" areas. Consequently, there may be certain actions which can be undertaken in "critical habitat" areas that would not be expected to result in such a reduction in either distribution or numbers of a species, or otherwise adversely affect a species (40 FR 17765).

The regulation of Endangered or Threatened species encountered by a future field survey along the proposed pipeline route would require a biological opinion from a regional Fish and Wildlife Service office for the following reasons: (1) the Federal status of Threatened species recommended by the Smithsonian Institution is at present undetermined; (2) no "critical habitat" areas have been designated at this time; and (3) certain actions within the forthcoming "critical habitat" areas may be approved by the Fish and Wildlife Service (Bruce McBryde, Washington [D.C.], U.S. Fish and Wildlife Service, 1977, tele. comm.).

Sea Leg

The Sea Leg has no known Endangered or Threatened plant species that would be impacted by the construction or operation of this project.

California

The Port of Long Beach has no known Endangered or Threatened plant species that would be impacted by the construction or operation of this project.

From the Port of Long Beach to the Colorado River, there is only one known proposed Endangered species.

1. Nevins Barberry, Berberis nevinii. It is classified as totally Endangered and approaching extinction. This species has been located on the north facing slope of San Timoteo Canyon (Powell, 1974) south of the Redlands Pump Station. It may be impacted by a transmission line corridor if electrical power for the Redlands Pump Station is derived from a close source located just south of this pump station. Also, accidental fire from construction activities within the fire-prone San Timoteo Canyon could impact individuals of this species.

East of California

Introduction. A ground survey over this portion of the pipeline route was not made. The geographic ranges and habitat types for the following species were reviewed in state flora texts (referenced in Chapter 2) and then compared with the habitats the pipeline crossed to determine if the potential exists for encountering Endangered or Threatened species. The discussions of habitat types here are not synonomous with the "critical habitat" areas of the Fish and Wildlife Service.

There are no proposed Endangered species recognized by the U.S. Fish and Wildlife Service (1976) known to exist along the pipeline corridor from Arizona to Texas. The following species have a Threatened status recommended by the Smithsonian Institution. These species are considered below because at a future date they may receive a Threatened status from the Fish and Wildlife Service, as discussed in Section 2.1.7.3.1.

Arizona

2. Neolloydia erectocentra var. acunensis, occurs in Maricopa County and Pinal County at elevations between 1,300 to 2,000 feet on hills, flats, and alluvial fans. The Gila and Coolidge pump stations occupy habitat sites and elevations where construction of the stations and ancillary maintenance corridors could impact this Threatened plant.

3. Neolloydia erectocentra var. erectocentra, occurs in southeast Pima County and west Cochise County at elevations from 3,000 to 4,300 feet; these county areas correspond to the Black Mountain and Redington pump stations, respectively. This Threatened plant occurs on hills, flats, and alluvial fan habitats; consequently, the construction of the above two pump stations and their ancillary facilities could potentially impact this plant.

New Mexico

4. Opuntia arenaria, occurs on sand dunes at Anthony and has been observed on the pipeline right-of-way. There is no pipeline construction taking place there. Individual plants of this Threatened species could be destroyed by maintenance vehicular use and ORV activity on the pipeline right-of-way. During pipeline operation, an individual of this species could be destroyed by an oil spill. The probability of its being destroyed depends on its proximity to the pipeline as well as the plant's position on dune topography.

Texas

5. Dune unicorn-plant, Proboscidea sabulosa. This Threatened species occurs in deep sand and may occur in the dune areas west of Odessa. The new pipeline construction from Jal to Midland crosses some dune regions (Figure 2.1.7.2-6), and the possibility exists that individual plants could be impacted.

3.1.7.3.2 State of California recognized Rare and Endangered species

Although field sampling by the applicant did not encounter any of the following species, five of these Rare and Endangered plants (Powell, 1974) listed for California in Section 2.1.7.3 are noted to occur in plant communities through which pipeline construction and operational activity would take place. The last four species listed here occur in the creosote bush scrub plant community (Munz, 1974). Because no locations for the last four species have been determined, impacts are addressed to the creosote bush scrub plant community and habitat descriptions (Munz, 1974) where these Rare and Endangered plants have a probability of occurring. The habitat types are not synonomous with the "critical habitat" areas of the Fish and Wildlife Service.

1. Nevins barberry, Berberis nevinii. This species is discussed in Section 3.1.7.3.1

2. Glandular ditaxis, Ditaxis adenophora. This species is a member of the creosote bush scrub plant community and occurs below 500 feet elevation on sandy flats (Munz, 1974). It is recognized as rare in California but not rare outside of the state. The area of new pipeline construction from Ford Dry Lake to the Palo Verde Valley would qualify as a potential habitat for this plant, and, consequently, this plant has a probability of growing here. Also, the transmission line corridor road servicing the Desert Center Pump Station must cross this habitat type.

3. Little San Bernardino Mountain Linanthus, Linanthus maculatus, is a member of the creosote bush scrub plant community and occurs in sandy places at elevation 400 to 500. This annual species is considered very rare and seldom seen because it occurs in such small numbers. There is the probability that this plant could occur along the new pipeline construction corridor at Ford Dry Lake. Also, the transmission line road leading to the Desert Center Pump Station crosses the creosote bush scrub plant community

and therefore this area constitutes habitat where the plant has a probability of occurring.

4. Scaley-stemmed sand plant, Pholisma arenarium, a parasitic plant growing on roots of cheese bush, Hymenoclea, and bur sage, Ambrosia, has the potential to occur within the pipeline construction corridor. The two shrubs parasitized are components of the creosote bush scrub plant community which is crossed by the new pipeline construction corridor as well as the power transmission line road for the Desert Center Pump Station. This species is noted as Endangered and declining in population; it is also considered rare outside of California.

5. Mojave fish-hook cactus, Sclerocactus polyancistrus, occurs on gravelly mesas and slopes at 2,000 to 6,000 feet elevation in the creosote bush community. This species is recognized as Endangered and declining in California and Rare outside of California. The transmission line maintenance road for the Desert Center Pump Station crosses this plant's potential habitat at the lower elevations.

3.1.8 Wildlife

3.1.8.1 Sea Leg and Port of Long Beach

3.1.8.1.1 Conversion/construction

Port of Long Beach area

Dredging and filling activities. The most obvious and direct impact associated with dredging is that entrapped organisms are removed with the dredged material. These organisms sustain high rates of mortality during the periods of dredging, transportation of dredged material, and deposition of dredged material. Secondary biological impacts are associated with turbidity created by the dredging and filling activities. Other secondary impacts are associated with the redeposition of suspended sediment on sessile organisms, causing burial and smothering of affected organisms.

The proposed dredging would necessitate the removal of about 2.5 million cubic yards of bottom sediment from about 79 acres of outer Long Beach Harbor's benthic substrate. This substrate provides habitat for numerous benthic organisms. The Allan Hancock Foundation (1975) generally determined that the outer harbor area supports a relatively diverse and abundant benthic community. According to the Long Beach Harbor Consultants' benthic investigation (1976), the species diversity in the area around their benthic Station 58 is relatively high. In fact, this station was one of six stations (from a total of 26 benthic stations) found to have the highest species diversity during their investigation period. The proposed dredging activity would occur very close to Station 58. (See Figure 2.1.8.1.3-8.) Therefore, there are definite indications that the proposed dredging will destroy benthic habitat of relatively high species diversity. The majority of the organisms within the limits of dredging would be dislodged and lost. In general, dredging to a depth of even a few meters effectively eliminates all benthic species, because most species live in the upper few centimeters of substrate and all live within 1 to 2 meters (AHF, 1975). Observations of a channel dredging operation employing a trailing suction hopper dredge in Coos Bay, Oregon, indicated removal of between 74 to 88 percent of the benthic organisms (U.S. Army Corps of Engineers, 1975).

The process of repopulation of dredge areas is generally known to take place rapidly after cessation of dredging activity. The Allan Hancock Foundation (1975) studies of the harbor complex indicate that postdredging benthic development may consist of several stages:

1. Creation of a new azoic substrate.

2. Primary modifications to this sterile environment through colonization by bacteria and accumulation of organic food stuffs.

3. Availability of larvae for resettlement and establishment of a relatively species-rich community.

4. Accumulation of pollutants.

5. Gradual elimination of pollution-sensitive species.

Regarding the potential recolonization of the proposed dredging area, the Allan Hancock Foundation (1976) stated:

> Benthic organisms would recolonize the slip bottom after construction, although possibly in reduced numbers. Studies indicate that recolonization can take place in the fine sediment settling almost immediately, provided that adjacent areas with reproducing populations are not damaged. In some seasons, juvenile populations similar to the original community are established in 12-18 weeks, and a mature population occurs in 2-3 years.

It must be kept in mind that this view disregards the impacts that oil spills could have on recolonization of the benthic habitat. The impacts associated with potential oil spills are discussed in a subsequent section.

There is little information available on the ability of organisms to survive transportation to aquatic disposal areas. In general, the survival of transported organisms is not considered as contributing significantly to the population of disposal areas (U.S. Army Corps of Engineers, 1975).

It is not specifically known what impacts would result from the deposition of dredged material at the EPA 100-fathom disposal site. According to a report by the Corps of Engineers (1975):

> Kranz conducted laboratory and field studies of 25 species of bivalves to determine the effects of catastrophic burial. He demonstrated that the exhuming ability of bivalves is closely related to their life habit. Borers, deep burrowing adult siphonate suspension feeders, and suspension feeding epifaunal forms were generally unable to escape sediment coverings thicker than 1 centimeter. However, shallow burrowing siphonate suspension feeders and young deep burrowers were usually able to escape from under 10 centimeters to 50 centimeters of their native sediment. A radical change from the native sediment type could be highly lethal by reducing the effective burrowing ability, and often burial in only 1 centimeter of an exotic sediment was fatal. Kranz found no simple correlation between living depth and exhuming ability. Temperature, salinity, and oxygen concentration seemed to have little effect on exhuming ability except near the extremes of a species tolerance. The nature of the native and deposited sediments and the life habits of the bivalves in question were the most important factors in determining survival.

It is generally expected that the deposition of dredge material will cause mortality of benthic epifauna and infauna. However, the degree of mortality cannot be determined primarily for the following reasons:

1. There have been no specific biological investigations made of this site.

2. Mortalities would probably be dependent upon other unknown and difficult-to-determine factors such as areal extent, thickness, and final deposited composition of the sediment load.

Further evaluation of potential impacts resulting from disposal would be conducted by the Corps of Engineers and EPA during the subsequent permitting process.

The dredging operation would entrain few juvenile or adult fish. However, some entrainment of fish with benthic larvae (i.e., toadfish) would occur. Flatfish also would be susceptible to entrainment because of their sharp transition from a pelagic postlarval stage to a bottom-dwelling juvenile stage.

The dredging would temporarily displace the croakers, anchovy, sand bass, and flatfish that inhabit the Pier J area. Fish not abundant near Pier J (surfperch, rockfish, gobies) would be little affected because of their distribution patterns. Survival of the displaced fish depends partly on the ability of adjacent similar habitats to support the increased food and space demands. There is no reason to assume enough suitable niches exist to prevent overcrowding. More competition for food and space would result in increased predation, stress, and malnutrition. Hardier species, such as white seaperch, gobies, white croaker, and California tonguefish, would probably be minimally affected by these factors.

A permanent impact from dredging would be that soft-bottom food organisms (polychaetes, clams) would be destroyed in the areas of dredging. This would impact the benthos (flatfish) and benthos feeders (croakers, surfperch) that feed on those organisms. Some mortality and different distributional patterns would result from destruction of the food supply and consequent overcrowding. Maintenance dredging, although not presently anticipated, would prolong these impacts over the life of the project. Dredging would create more deep-water habitat. Deepening the project area would have little effect on its actual use as a nursery area and would benefit young croakers, queenfish, and anchovy (Cronin et al., 1971). By encouraging the more dominant fish in the harbor, a further population imbalance may be created, resulting in decreasing numbers and types of nondominant fish. Although the anchovy would benefit, the live-bait fishermen probably would not. Live-bait fishing would be restricted because of shipping activity in the newly dredged channel and the unavailability of anchovies to existing fishing techniques (Brewer, 1975). The bait fishery might relocate entirely because of shipping activity. Both of these restrictions could cause a decrease in the amount of fish captured per unit effort and subsequent economic problems for the live-bait fishermen. Approximately 1.8 percent of the present bait-fishing area in the harbor will be removed by dredging and breakwater construction. An estimated $25,000 would be lost annually.

Turbidity -- Turbid waters resulting from dredging and filling activities will affect harbor fauna. Insight into these effects has been derived from the Corps of Engineers' Final Environmental Impact Statement "Maintenance Dredging, Existing Navigation Projects, San Francisco Bay Region, California" (Corps of Engineers, 1975). Much of the information from this document has been used as a basis for the following discussion.

A large number of invertebrates within the harbor complex's benthic and rocky shore communities are filter feeders. Many species of bivalves and benthic worms fall into this category. Increased concentrations of suspended solids can cause the filtering apparatus to become clogged. If the concentrations are too great, the organisms may actually cease their filtering activities, causing stress and possible mortality. The sensitivity of the organisms is found to vary with particle concentration, mean particle size, particle composition, water circulation, oxygen content, pH, water temperature, and the life stage of the organism's development. The adverse effects can vary considerably from species to species. Suspended sediments caused by dredging and filling activities can affect the harbor's zooplankton population in several ways. The suspended sediments can cover eggs, reducing their viability or impairing the normal development of larvae, or interfere with feeding mechanisms. Within the area of the dredging plume inside the harbor, increasing BOD would decrease the dissolved oxygen level, resulting in mortality and stress to marine organisms. Odum (1970) pointed out that dredging-related oxygen depletion ranges from "relatively unimportant" to complete removal of oxygen. Direct effects of oxygen depletion would include mortality to fish and their food organisms. This would indirectly affect fish feeding on those organisms. Other indirect effects of lowered DO to fish would include increased exposure to toxicants (i.e., pesticides) because more water is moved over the gills. Gill lamellae exposed to toxicants thicken, become less efficient, and therefore even less tolerant to lower dissolved oxygen (Johnson, 1968). Cessation of dredging and filling activities would allow for a reestablishment of the zooplankton population.

Turbidity would cause the juvenile and adult fish to leave the area. Suspended sediments can clog and damage fish gills. Ventilation rates would then increase. The expended energy might be made up by decreased activity (Horkel, Pearson, 1976). Turbidity would also reduce feeding efficiency of sight feeders such as speckled sanddab. The direct effects of turbidity should cause some population decrease.

High turbidity reduces light penetration of the water. This alters the total developmental interval and embryo development (Lagler et al., 1967). Any change in developmental times increases the chance of predation and overcrowding because of overlapping hatching and developing periods. A significant reduction in reproductive success, either to spawning adults or eggs and larvae, may be of greater ecological importance than the loss of part of the existing populations (Corps of Engineers, 1975).

Redeposition of suspended sediments -- Redeposition of suspended sediments would occur on benthic and subtidal rocky shore habitats adjacent to the dredging area. Because most of the benthic habitat organisms are motile infaunal species, additional sediment loading to the extent of a few centimeters, as would be the general case, is not expected to cause significant mortality rates. Gotshall, (Calif. Dept. of Fish and Game, 1971) monitored the Corps of Engineers' 1971 dredging operation in outer Anaheim Bay (located about 5.5 miles downcoast from the proposed dredging area). He stated that it seemed little if any damage was done to the biota adjacent to the actual area of dredging (California Dept. of Fish and Game, 1971). However, this operation was conducted using a hydraulic cutter head dredge, and excavation was done in benthic sediments considered by the Corps of Engineers as being suitable for beach nourishment at Surfside-Sunset Beach. Therefore, the type of dredge and the kind of material removed caused a lesser degree of impact on adjacent communities than is expected for the proposal discussed in this Environmental Statement. In general, sessile or other nonmotile epifauna and boring, deep-burrowing adult siphonate suspension feeders and suspension feeding epifaunal forms of bivalves are probably most weakened or destroyed by the deposition of only a few centimeters of sediment. It is expected that these types of organisms, which are found in subtidal rocky shore and benthic communities adjacent to the area of proposed dredging, would suffer the greatest mortality. Destruction of these fish foods would stress fish normally feeding in the area. Adjacent fish populations would also be stressed because of increased competition for food and space. The effects of redeposition of suspended sediments on the adjacent communities are expected to be short-term.

Breakwater. The breakwater construction would probably occur simultaneously with the dredging operation. The core of the breakwater would be composed of dredged material. The base of the proposed breakwater would cover about 21 acres of existing benthic habitat. According to investigations conducted by the Long Beach Harbor Consultants (1976) and AHF (1975), the benthic habitat in the vicinity of the proposed breakwater is a community of relatively high species diversity, as previously discussed under the impacts of dredging. Some of the dredged material will be used for the core of the Pier J breakwater. Some runoff will occur, temporarily increasing BOD, nutrient concentrations, and turbidity. The impacts should be insignificant.

The breakwater, if considered a solid structure (no voids), would displace about 1.13 million cubic yards of harbor water volume. These 1.13 million cubic yards of water act as a living, feeding, and transportation medium for zooplankton and fish and a feeding medium for marine-associated avifauna.

The breakwater's outer layer of armor stone would provide about 3 acres and 17 acres, respectively, of new intertidal and subtidal rocky shore habitat. For this discussion, the intertidal zone is defined as the zone between the +7.0-foot and <1.8-foot tidal levels and the subtidal zone is defined as the zone below the <1.8-foot tidal level. The rocky shore communities expected to develop would probably be similar to the communities already associated with the landward side of the San Pedro, Middle, and Long Beach breakwaters and with the Pier J revetment. As a general overview of epifaunal colonization, all the dominant species of invertebrates found by the Long Beach Harbor Consultants at their outer Long Beach Harbor stations, as presented in Table 2.1.8.1.3-15, would probably colonize the breakwater. Numerous other species would also colonize the structure with species diversities varying from one side to the other. The variance would be largely related to abiotic factors such as water spray, light exposure, water circulation, and other water quality parameters.

As previously mentioned in the section on construction impacts on vegetation, the breakwater would further shelter the seaward face of the Pier J rocky shore revetment from wave action. This reduction in exposure to wave energy would bring about a modification of the faunal composition on the Pier J shoreline. The faunal species diversity would probably become lower.

Construction of the breakwater would cause a temporary local loss of those fish in the area. The breakwater would cover and destroy 21 acres of soft-bottom habitat. This would directly reduce the food supply, particularly for croakers and flatfish. However, an insignificant amount of bottom would be removed. The impact would be partly alleviated upon completion of the breakwater by introducing additional hard substrate.

This new substrate should yield typical rocky-shore communities. The food supply would be different from that of the soft bottom, preventing many species of previously displaced fish from using the newly created habitat. The numbers of white shiner and rubberlip seaperch, _Rhacochilus toxotes_, and rockfish should increase with enlarged rocky-shore habitat. The rock crevices would provide habitat for black croaker, _Cheilotrema saturnum_; black perch, _Embiotoca jacksoni_, and blennies. The sand/rock ecotone provides excellent living space for barred sand bass, _Paralabrax nebulifer_ (Valentine, 1971). These beneficial aspects of the breakwater might be eliminated or reduced by increased siltation caused by prop wash and by the chance of oil spills. Populations would then be unstable and resemble the area off the Navy Mole as observed by Marine Biological Consultants, Inc. (Long Beach Harbor Consultants, 1976).

Construction of the breakwater and dredging activities south of Pier J would affect, through displacement, the marine-associated avifauna and mammals that feed, rest, or move through the project area. The 1973-74 ornithological surveys (AHF, 1975) of Long Beach Harbor did not reveal that the open water area south of Pier J was an important feeding and/or resting area for marine-associated avifauna.

However, some impact on feeding and resting habitat would occur to such species as Forster's tern, black-legged kittiwake, Bonaparte's gull (feeds extensively in open water of outer harbor), brown pelican, Brandt's double-crested and pelagic cormorants, and grebes. The newly constructed breakwater would create additional resting space for gulls, shorebirds, and brown pelicans and feeding habitat for shorebirds.

The proposed project would have a negligible impact on terrestrial wildlife. Limited weedy annual vegetation providing some food for land birds would be replaced by ornamental plants with more wildlife cover and food values. No bird nesting habitat will be eliminated.

Trestle. Proposed trestle piles would provide approximately half an acre of benthic habitat. This benthic habitat is similar to that previously mentioned in connection with breakwater construction impacts on benthic communities. Specifically, the trestle piles would provide about 9 acres and 48 acres of intertidal and subtidal surface habitat for piling organisms, respectively. On the basis of existing information concerning the piling communities within the harbor complex, it is difficult to determine what invertebrate species would colonize the trestle piles. The Allan Hancock Foundation's piling community investigation dealt only with inner Los Angeles Harbor. Because the abiotic and biotic conditions of the inner and outer harbors are markedly different, the Hancock Foundation's findings cannot be applied to a piling habitat in outer Long Beach Harbor. Studies by Environmental Quality Analysts and Marine Biological Consultants, Inc. (1975) generally indicated that there was an increase in rocky shore species diversity from inner to outer Long Beach Harbor. In general, many of the organisms associated with a piling community are also found in a rocky shore habitat. It would seem reasonable to assume that a general increase in species diversity from inner to outer harbor areas is also associated with piling communities. Therefore, a community that would establish on the trestle pilings should be at least equal to, and probably greater in, species diversity than that occurring on the pilings in the inner Los Angeles Harbor. (See Figure 2.1.8.1.3-15 and Table 2.1.8.1.3-16.)

The trestle pilings would displace about 46,000 cubic yards of harbor water volume that is a living transportation and feeding medium for zooplankton and fish and a feeding medium for certain species of marine-associated avifauna.

Year 2000. The cumulative impacts of the project would be the loss of 22 acres of soft-bottom habitat and the loss of about 1.18 million cubic yards of productive water volume. These impacts become more significant when the general trend for development of the harbor (the Port of Long Beach general plan proposes extensive fills reducing the water area by about 30 percent) is considered.

Terrestrial wildlife -- Landfilling of Long Beach Harbor waters would create some new terrestrial habitat that would provide limited wildlife habitat benefits (e.g., rodent habitat, resting and feeding areas for some bird species) following landscaping and very limited natural development of vegetation.

3.1.8.1.2 Operation

Ocean

Primary impacts upon marine fauna would be from crude oil. Chronic low level leaks and large occasional spills present a serious threat to marine animals. In this section examples of refined petrochemical (diesel and fuel oils) spills are used because of lack of relevant oil-spill information. It should be noted that refined petrochemicals are more toxic than crude oil. In Section 3.1.2.1.2 there is a discussion of how oil deleteriously affects marine organisms, of variables that alter the extent of the impact, and of minimum persistence times for oil. Section 3.1.2.1.2 should have been read prior to this section.

Emphasis should be placed on the fact that chronic low level pollution can cause subtle changes in organisms and is potentially more dangerous to the ecosystem than dramatic, catastrophic spills (Evans and Rice, 1974).

The following discussion of impacts covers, in the following order, zooplankton, intertidal communities, subtidal benthic communities, and fishes, marine mammals, and seabirds.

Zooplankton. Little information has been found concerning the effect of crude oil on the zooplankton. Mironov (1969, as cited by Mironov, 1972) stated that some copepods are sensitive to 1 ppm suspension of fresh or weathered crude oil and diesel fuel. In a review paper, Hufford (1971) cited one experiment which showed accelerated death of zooplankton exposed to diesel oil (0.1 percent for 5 to 60 minutes) as compared to nonexposed zooplankton.

Following the Arrow incident in Chedabucto Bay, Conover (1971) observed plankton ingesting large quantities of small drops of Bunker C oil and eliminating them in the form of fecal matter (up to 7 percent Bunker C oil by weight). Unfortunately, no chemical analysis of the fecal matter or of the whole copepods was reported that might have provided some indication of whatever degradation or partitioning of the oil, if any, took place.

Parker (1970) also found the presence of considerable quantities of oil in the guts of copepods and barnacle larvae and in their fecal pellets. Apparently the oil passes unchanged through the digestive system and then is precipitated in the denser-than-seawater feces. This grazing effect is of considerable ecological importance. It exposes planktivores to the ingested oil in the animals and releases the oil in fecal material to become incorporated into the sediments (where it usually persists) or to be eaten by other members of the food chain.

Lee (1975) shows that zooplankton rapidly take up various hydrocarbons in seawater solution. Experimental animals were copepods, euphausiids, amphipods, crab zoea, ctenophores, and jellyfish from the coasts of California, British Columbia, and the Arctic. Uptake was linear for 24 hours with no further increase in stored hydrocarbons after that time. The crustaceans (copepods, euphausiids, amphipods, and crab zoea) metabolized the hydrocarbons but not the ctenophores or jellyfish. Up to 22 x 10^{-4} μg of benzopyrene was ingested by the copepod, Calanus plumchrus (occurring in Gulf of Alaska waters), while transfer of the copepod to fresh seawater resulted in the discharge of most of the benzopyrene with less than 1 x 10^{-5} μg remaining after 17 days, no further hydrocarbon loss was observed. Incomplete depuration was also observed in the copepod, Calanus hyberboreus, an Arctic species. The copepod took up 11 x 10^{-4} μg of benzopyrene and after a 28-day depuration experiment, still showed the presence of the benzopyrene (1 x 10^{-5} μg).

Uptake, storage and depuration has also been shown for other zooplankton species. Brachionus, an abundant rotifer genus found in fresh and saline waters (Ramadan et al., 1963), accumulated ^{14}C -- labeled benzene, a monocylic aromatic hydrocarbon which is a major component of the water-soluble fraction of crude oil (Echeverria, draft report). Both acutely (single dose) and chronically treated rotifers accumulated ^{14}C compounds to the same magnitude. In all treatments and types of exposures, 10^3 to 10^4 times the water concentration was reached and maintained. The ability to store large quantities of pollutants makes rotifers available to pass on pollutants through the food chain to larval fish and other invertebrates.

The larval and young of many benthic and fish species are components of zooplankton, including commercially important species. Sponner (1971) reports that concentrations of crude oil at 100 ppm are fatal to barnacle nauplii. Crude oils also have been reported to be toxic to the planktonic eggs and larvae of some fish (Kuhnhold, 1969). The sensitivities of fish larvae to hydrocarbons would vary. The larvae and eggs of fish and benthic organisms would be especially vulnerable to oil spills since many are concentrated near the surface of the ocean as part of the neuston community. High mortality of the neuston could be expected in the area of an oil spill. Damage to the year class strength of species of fish may occur.

Intertidal communities. As discussed in Section 3.1.7.1.2, crude and refined oil can have devastating effects on intertidal algae, completely denuding the shore. Such losses of algae would, of course, profoundly impact intertidal animals, many of which feed upon the algae. In addition to destroying the food source of many intertidal animals, oil can kill the animals directly. Anderson et al. (1969) summarized the effects of the Tampico Maro spill in Baja California (19,000 barrels of diesel fuel were spilled into a cove having restricted circulation).

> Immense surf had apparently mixed sand particles with oil films, creating a sludge that rested in depressions and basins on the sea

> floor. Effects on the fauna were severe. Dead animals were observed wherever natural accumulation of beached debris occurred. Rotting tissue odors were often detectable more than 100 feet from the beach. Species most frequently noted were abalone, Haliotis cracherodii, H. fulgens and H. rufescens; lobster, Panulirus interruptus; pismo clams, Tivela stultorum; mussels, Mytilus californianus; urchins, Strongylocentrotus franciscanus, S. purpuratus; and sea stars, Pisaster giganteus, P. ochraceus. Abundances of these dead organisms left no doubt that a most abnormal condition existed. For example, one heap about 300 feet from the wreck contained 69 abalones (all with decaying bodies still in the shell), five lobsters, two fishes, and a variety of mussels, urchins, crabs, sea stars, and smaller invertebrates. Many similar accumulations occurred along the beach as far away as Punta Cabras, more than two miles south of the wreck. Tidepools about five miles south still displayed oil films. Populations of the normally submerged snail, Tegula funebralis, had emerged from these pools and were clinging to dry rocks around the edge of each pool. At shallow depths near the wreck, large numbers of dead urchins and mussels had accumulated with sludge in basins. The benthos appeared normal at depths greater than 25 feet.
>
> A large anemone Anthopleura xanthogrammica, remained in tidepools. This anemone probably tolerates oily substances because the species was noted in the discharge system of an oil refinery using seawater for industrial purposes.

Chan (1973) studied the impact of the San Francisco oil spill which occurred on 18 January 1971 when two Standard Oil vessels collided almost directly under the Golden Gate Bridge, releasing 840,000 gallons of Bunker C fuel. This asphalt-like oil was washed up on intertidal shores of the area approximately 30 hours after the spill.

From comparative transect and laboratory observations, it was determined that marine organisms died from being smothered by oil, with certain species, such as acorn barnacles and limpets, suffering the highest mortality. Comparison of preoil and postoil transect counts showed there was a significant decrease in marine life after the oil spill on the reef. Marine snails suffered less mortality than the sessile barnacles and other sedentary animals. The normally large population of striped shore crabs was missing from the rocky crevices.

The spill of No. 2 fuel oil in West Falmouth, Massachusetts, from the tanker Florida resulted in a high number of mortalities among intertidal and beach (area above high tide) fauna. This spill eventually covered nearly 3 miles of coastline and resulted in high mortalities (Blumer et al., 1971). Results from studies of this spill demonstrate that immediate catastrophic and later chronic effects can result from a single oil spill (Sanders, 1973).

Sandy intertidal areas in the Gulf of Alaska support recreational fisheries for six species of clams and a commercial fishery for one species, Siliqua patula. More than 29,747 pounds of Siliqua patula, a razor clam, were harvested from Prince William Sound alone. And this species is harvested extensively in California also. Razor clams, littleneck clams, surf clams, and other bivalves are all highly vulnerable to oil spills. Although there is disagreement on the ability of bivalves to purge themselves of oil, there is no disagreement that after initial exposure, oil is accumulated in the animals' tissue (Blumer et al., 1970; Anderson et al., 1973; Lee et al., 1972). Oil persistence time for a typical clam and worm flat is at least 10 years; 3 years for an open coast sandy beach. It is apparent then, that after a large spill, these animals would be continually exposed for long periods. Even if they do have the ability to depurate oil, recontamination would occur for an extended period. This would eliminate the clams from commercial and recreational harvests (contamination) and possibly destroy the population itself.

Pacific herring, Clupea pallasi, are important planktivores from Valdez to Long Beach. They are an important food source to any large carnivore, such as the fur seal. In addition to their biological importance, they are commercially valuable. In certain areas, including Prince William Sound, Pacific herring deposit their eggs on vegetation and rock in the intertidal and shallow subtidal zone. Since 1970, Prince William Sound has been Alaska's most important herring-eggs-on-kelp area with annual production in 1970 worth a quarter of a million dollars. Struhsaker (1976) studied the effects of benzene, a toxic component of petroleum on spawning behavior of Pacific herring. She found that spawning females and ovarian eggs are the most sensitive stages. At the parts per billion concentration levels, an exposure for 48 hours caused a significant reduction in the survival of eggs and resultant larvae. A severe disruption in behavior was also noted, including disruption of milling, disequilibrium, gaping at the surface, and premature spawning. Struhsaker also commented that "the percentage of survival of eggs through hatching is significantly less (approximately 25% less; $P<0.01$) in Pacific herring eggs collected from San Francisco Bay than in those from Tomales Bay. This reduction in hatching success may well relate to the effects of accumulated pollutants in the gonads of spawning fish in the relatively more polluted San Francisco Bay waters -- it is possible that long-term chronic exposure to low (pptr/ppb) levels may be decreasing population survival in polluted areas." The unavoidable increases in chronic pollution and possible major spills can be expected to produce major deleterious impacts upon herring and probably many other species of fish. Two of the more important "other" species are pink and chum salmon.

In the Port Valdez area, an average of 74 percent of all spawning of these species occurs intertidally. Rice (1973) has noted that in laboratory studies, pink salmon fry are able to detect low (immediately) sublethal concentrations (1.6 mg/l of oil) of Prudhoe Bay crude and show avoidance behavior to it. Nelson-Smith (1971) has stated that fish seem to avoid contaminated areas. While this has survival value for the individual fish, it could well lead to a cessation of spawning in an area subject to chronic pollution and the resultant elimination of that species from the area. Impacts upon fish are discussed in greater detail in the following sections.

The aesthetic and recreational value of the intertidal zone is considerable. Oil pollution would adversely impact these uses of the intertidal zone in addition to the biological and commercial uses discussed above.

Subtidal benthic communities. Since many intertidal organisms are also found in the shallow subtidal zone, most of the previous material applies here as well. Spilled oil which has not evaporated or been cleaned up or stranded on a beach, after being dispersed into the water as droplets, adheres to particulate matter and sinks to the bottom where it comes into contact with the benthos.

Data of Sanders, Grassle, and Hampson (1972) show immediate and nearly complete mortality of many forms of benthic animals following the spill of No. 2 fuel oil near West Falmouth, Massachusetts. The bivalve molluscs (clams, etc.) seemed especially vulnerable. Chemical analysis of edible shellfish species following the West Falmouth spill revealed that the fuel oil had been absorbed or ingested and could subsequently be found in oyster bodies and scallop muscles in quantities sufficient to require the closure of shellfish beds to harvesting (Blumer, Souza, and Sass, 1970). As a rule, when levels of oil concentration in the sediment apparently decreased below a certain level with the passing of time, affected areas were recolonized by opportunistic forms, especially the marine polychaetous worm Capitella capitata. This generally occurred within three to six months of the initial oiling. With the passage of about 10 to 20 months, the more sensitive molluscs resettled many areas. However, at some harbor stations which apparently received a heavy oiling, some highly sensitive forms, such as ampeliscid amphipods had not returned after 20 months.

In Santa Barbara at Platform A (where blowout occurred) Juge (1971) found no burrowing organisms or evidence of them in box cores taken from heavily oiled sediments.

The question of the accumulation of petroleum hydrocarbons in the food chain remains an interesting, but largely unanswered question.

Blumer et al. (1970) reported that when oysters, Crassostrea virginica, are exposed to oil-water mixtures, they nonselectively accumulate in their tissues a wide variety of petroleum hydrocarbons which are retained indefinitely. This would mean the ingredients for food chain accumulation are present and favor the ability for ample magnification.

More recently, Lee et al. (1972) exposed the mussel, Mytilus edulis, to isotopically labeled petroleum-derived alkanes and aromatic hydrocarbons and showed that the molluscs released more than 90 percent of the accumulated hydrocarbons within two weeks of return to isotope-free seawater. Anderson et al. (1973) also reported depuration of oil accumulated in oyster and clam, Rangia cuneata, tissues within 28 days to background levels. They concluded that the accumulation and release pattern indicates that under natural conditions, food chain accumulation of petroleum hydrocarbons would not occur.

In sediments chemical degradation of oil can occur but is restricted to the surface layer of the bottom penetrated by ultraviolet light. Ahearn (1973) stated that research on microbial utilization of hydrocarbons for treatment of oily pollutants in the environment, though more intensive in recent times, is still in an early stage of development. It is known that microorganisms can degrade much of a crude oil, particularly the less toxic paraffinic compounds. No single species can degrade all the compounds, but many different species together can metabolize a large number of the compounds, if not all. The rate of microbial degradation, which is principally aerobic, decreases with a decrease in temperature. Large quantities of oxygen are needed. It has been estimated, for instance, that complete oxidation of 1 gallon of crude oil would require all of the dissolved oxygen in 320,000 gallons of water. This comparison may be unrealistic because most oil is at the surface of water in contact with air, and only the outer surfaces of oil can be attached at any one time. It is reasonable to assume, however, that an oxygen-deficient environment may well occur under some oil slicks and in oil-contaminated sediments.

Blumer and Sass (1972) noted that "The preservation of hydrocarbons in marine sediments for geologically long time spans is one of the accepted key facts in current thought on petroleum formation." However, in spite of the stability of hydrocarbons in marine sediments, there are characteristic differences between the hydrocarbons in polluted and unpolluted areas. Tissier and Oudin (1973) found that hydrocarbons in polluted sediments differed from those of unpolluted sediments by having lower percentages of heavy components, by not having an odd carbon dominance in the n-alkanes, and by having polycyclic aromatic hydrocarbons with alkyl chains.

Much of the oil from the Santa Barbara blowout is believed to have settled in the Santa Barbara Channel (Battelle Northwest, 1970) where oxygen is already deficient and is probably not present in sufficient quantities for further decomposition.

The West Falmouth spill provided a unique opportunity for a study of the immediate and long-term effects of an oil spill on an area where the previously existing environmental base was well known (Blumer, Sander, Grassle, and Hampson, 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer, Sass, Souza, 1970; Sanders, Grassle, and Hampson, 1972). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer, Souza, and Sass (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be the source of a chronic pollution problem near that spill.

Newell (1948) and Valentine (1966) suggested that a significant number of endemic molluscs, some with a distribution restricted to 1° or 4° latitude, occur in California. Significant numbers of endemic species undoubtedly occur in the Gulf of Alaska as well. This endemism also occurs in other taxonomic groups (pers. comm., Newman, 1974). It is easy to speculate on the obvious implication of this: Severe or chronic alteration of comparable areas of the environment could eliminate endemic species forever. It is doubtful that a single large spill could wipe out many, if any, subtidal benthic species by itself. The effect of widespread chronic oil pollution or a large oil spill in combination with other types of environmental alterations is not known, but could conceivably contribute to the extinction of some of these endemics.

The diversity of standing crop in the basins off southern California is far less than that of the shallower shelves (Hartman, 1960). Because of the more sparse distribution and possible greater sensitivity of any of the basin benthos, oil on the bottom here could cause a greater impact on the basin community than a shallower shelf community. Some of the important commercial benthic species which are vulnerable to oil pollution are discussed below.

King crab, Paralithodes camtschatica and P. platypus, have supported a vigorous commercial fishery for more than 20 years (Buck, 1973) with more than 7,005,596 pounds of king crab harvest in Alaska between January and July, 1976 (Alaska Department of Fish and Game, no date). Gray and Powell (1966) showed that breeding takes place in very shallow water, intertidal to 20 meters. The larval stages are planktonic and stay in shallow water for 10 to 12 weeks. Young crabs remain in these shallow areas for up to four years before moving into deep water (50 to 350 meters) where most adults are captured. The life cycle just described makes king crabs extremely vulnerable to oil pollution. Major spills could eliminate entire-year classes, while petroleum persistence from such spills and low level chronic pollution would probably significantly reduce the viability of eggs, larvae, and young.

Work is currently being done which shows that concentrations of hydrocarbons measured in parts per million (ppm) interfere with the shore crabs' chemoreceptive ability, thus interfering with their ability to feed, find mates, and so on. If this effect applies to king crabs and the crabs discussed below, additional deleterious impacts from oil would result, and the crab population decline would be accelerated.

Tanner crabs, Chionoecetes bairdi, C. angulatus and C. opilo, are one of the most abundant marine invertebrates in the Gulf of Alaska. They range from shallow waters of less than 30 meters to depths of more than 2,000 meters. Hitz and Rathjen (1965) found that 22 percent of the invertebrate catch in the eastern Gulf of Alaska was Tanner crab. The only invertebrate encountered more often was the heart urchin. Tanner crabs obviously are extremely significant biologically. They have also begun to support a major fishing industry. Between January and July of 1976, 78,859,708 pounds were taken in Alaska with 6,000,000 pounds from Prince William Sound. Three aspects of the life cycle make Tanner crabs very vulnerable to oil impacts: (1) Breeding occurs in shallow water and lasts from January to May; (2) females carry the eggs for 11 months; and (3) upon hatching, larvae spend time as plankton before settling to the bottom. The highest levels of oil can be expected to be in shallow water, affecting the breeding and planktonic stages. Eggs are extremely susceptible to trace levels of hydrocarbons. The long carrying time for Tanner crab eggs greatly increases the probability that the eggs will be exposed with subsequent losses.

Another important species is the Dungeness crab, Cancer magister, which is found along the entire tanker route. This crab is generally harvested inshore between 50 and 100 meters. They spawn from the intertidal to 200 meters and larvae are planktonic for about three months. This crab would probably suffer fewer losses (long- and short-term) from oil pollution than king and Tanner crabs.

Other important invertebrates, which would be expected to suffer a reduction in numbers, individual size and vitality as a result of chronic leaks and major spills, include: shrimp, Pandalus, Cragon, and Hippolytid; scallops, Patinopecten and Hinnites; abalone, Haliotis; and lobster, Panulirus. Abalones and lobster populations are both declining in central and southern California as a result of intense commercial and recreational fishing pressure and poor water quality. Both lobsters and abalone grow very slowly and live in shallow water. Additional stress on them from increased oil pollution could virtually eliminate these species from certain areas.

Fishes. Both chronic low level pollution and major spills would have their most severe impacts upon eggs, larvae and fry. Adult fish, as with most organisms, are more resistant to environmental stress than other life stages. An exception to this may be anadromous fish, such as salmon, at the time they are migrating toward the coast to spawn. Anadromous fish are in a weakened condition at this time and are undoubtably more vulnerable to stress. Also as their migration is directed largely through olfactory uses. If the olfactory apparatus is disrupted or subtle cues masked by petroleum hydrocarbons, these fish could fail to return to their spawning styream.

The following general discussion is largely taken from the Outer Continental Shelf (OCS) Sale 35 EIS (USDI, 1975). Hufford (1971) cited several early studies which show that crude and bunker oils harmed or killed fish eggs in laboratory experiments. Mironov (1969) reported concentrations of crude oil at 0.001 mg/l (1 ppm) were toxic to eggs of anchovy, scorpion fish and sea parrots of the Black Sea. He also cited Mironov (1970) who found that oil affects fish respiration by clogging gills and damaging gill tissue. Blanton and Robinson (1973) support this finding. They found gill damage to specimens of seven different species of fish exposed to a Louisiana oil spill.

Morrow (1974) reported significant mortalities to young coho and sockeye salmon when crude oil poured on the water surface reached 500 ppm or greater. Morrow suggested that the toxicity of unsaturated aromatic compounds probably results from alterations of cell membrane permeability, especially in the gills, by dissolution of fatty substances from them. This, in turn, destroys the ability to regulate salt balance. This results in a rapid increase of monovalent ions in the blood and probably also interferes with CO_2-HCO_3 regulation.

The effects of direct kill and gill damage would be restricted to epipelagic (ocean zone from 0 to 150 meters) fish, neritic (nearshore) fish, and nektonic invertebrates in the upper layers of the ocean in the event of a massive spill.

Ahlstrom (1959) states that fish larvae in the southern California borderland area are concentrated in the upper mixed layer of the ocean and the upper part of the thermocline between the surface and 125 meters. The Northern anchovy and Pacific hake larvae were the most abundant in this layer from the CalCOFI surveys from 1955 to 1958 (Ahlstrom, 1965). Not only would these larvae be exposed to direct kill from water-soluble fractions of petroleum hydrocarbons, but also they would be most vulnerable to death from starvation in the event of a massive spill that killed off their food supply of phytoplankton and zooplankton. According to Hunter (1972), anchovy larvae, just after yolk absorption, require up to 37 times the food density as older larvae. If this food were not available over a large scale, the year class strength of the anchovy or other species might be damaged. The maximum damage from this impact would occur in the winter and early spring when peak fish reproduction takes place.

Many species of plankton would ingest and/or accumulate oil. Even if oil did not harm plankton, plantivores feeding upon the contaminated individuals would be exposed to both immediate and delayed physiological and behavioral stresses and possible food chain accumulation. For example, copepods in the zooplankton, ingest oil without apparent harm, but are an important food source for the epipelagic northern anchovy (Horn, 1974). The Northern anchovy occupies a central position in the trophic structure of southern California waters. It is one of the most abundant species in the region according to Smith (1972) and is a source of food for large game fish in the area such as bonito, albacore, and bluefin tuna. Therefore, the petroleum hydrocarbons have the potential of reaching up to the top layers of the food chain. Blumer (1973), as stated by Clark (1973), said the hydrocarbons contained in the zooplankton upon which the basking shark fed had passed through the digestive tract without fractionation or structural modification. These hydrocarbons were deposited in the shark's liver.

Contrary to the above, some evidence suggests that the classical food-chain buildup does not occur with petrochemical hydrocarbons. However, some investigators feel that the fact that the animals tested do accumulate hydrocarbons in rather large quantities indicates that temporary food chain buildup can occur. The naphthalenes remain within the prey species the longest and are also among the most toxic petroleum fractions (Anderson et al., 1974). The carcinogen benzopyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzopyrene reach high enough concentrations in predators, death or possibly cancer could result. The impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem than if the classical food chain buildup did occur.

After the Santa Barbara oil blowout in 1969, the California Department of Fish and Game (1969) found no damage to the nekton resulting from oil contamination. They looked at fish abundance by trawling samples and sonar transects. Examination of the Santa Barbara Underwater Gardens Aquarium also revealed no adverse effects. However, since fish abundance varies greatly in space and time and sampling methods are generally crude, it is difficult to definitely conclude that oil pollution does not affect fish abundance. From diver observations, the Department of Fish and Game reported that fish reacted to the surface oil as if it were a floating kelp bed. Ebeling et al. (1970) observed no effects on the nekton except for the temporary disappearance of mysid shrimp from kelp canopies.

A number of researchers at the National Marine Fisheries Service, Tiburon Laboratory, California, have investigated the effects of oil on fish. Korn, Hirsch and Struhsaker (1976) investigated uptake distribution and depuration of benzene in anchovies, Engraulis mordax, and striped bass, Morone saxatilis. Both species exhibited a rapid uptake (at sublethal concentrations). Uptake in the anchovy was greater than in striped bass. "In general, accumulation was greatest in the gall bladder, followed by mesenteric fat, colon, intestine, liver, brain, gill, heart, stomach and muscle. The gall bladder accumulated 8,450 times the initial water concentration, while muscle accumulated 135 times the initial water concentration. Maximum concentrations were obtained in the tissues from .25 to 4 days after starting exposure. Benzene and/or metabolites accumulate predominantly in tissues that exhibit a high liquid content or represent major metabolic sites. Thus, lipid-rich mesenteric fat and brain tissues had high accumulations; . . .."

High uptake in the lipid-rich ovaries also was found, and as previously discussed, this markedly reduced the viability of the eggs and resultant larvae. The authors also discovered that for these two fishes, residues were depurated rapidly after cessation of exposure.

However, invertebrates species from several different phyla have been shown to be incapable of metabolizing aromatic hydrocarbons. Fish could be deleteriously impacted by feeding on such organisms. Much more work needs to be done with respect to possible food chain magnification.

Korn, Struhsaker, and Benville (1976) studied the effects of sublethal levels of a water-soluble component of crude oil (benzene) on the efficiency of energy utilization in striped bass, Morone saxatilis. To determine if these sublethal exposures would inhibit energy utilization growth (net weight and dry weight), fat content and caloric content were determined. "Wet weight, dry weight and fat content decreased with increasing concentration (of benzene) as expected," the authors wrote. They also found ". . . an apparent acclimation of the fish to benzene at the low level (3.5 µl/l) by the end of the four-week exposure, as reflected by the dry weight of the fish . . . (and) improved feeding response . . . ."

To study the effects of environmental factors, physiological states of an organism are often used. Respiratory metabolism has been shown to be a sensitive parameter in evaluating such stress. Studies have been made of the respiratory response of chinook salmon, Oncorhynchus tschanytscha, and striped bass, Morone saxatilis. Increases of 115 percent occurred in 24 hours for striped bass and in 48 hours for chinook salmon, exposed to 5 ppm benzene. At exposures of 10 ppm benzene, respiration was depressed. If salmon beginning their upstream spawning migration were exposed to oil and suffered altered respiratory rates, it could significantly reduce the number of fish that would reach the spawning area.

Todd et al. (1972) and Hasler (1970) have shown that feeding, reproduction, and social behavior in fish and lobsters have been disrupted by soluble aromatic derivatives as low as 10 to 100 parts per billion (ppb) (Todd et al., 1972). Interference with predator detection of prey is also possible. Whittle and Blumer (1970) report that predators are attracted to prey at the ppb level. This low-level interference could also disrupt migratory and homing detection (Nelson-Smith, 1973).

Blumer (1969) has proposed that physiological/behavioral effects may interfere with fish nutrition by: (1) blocking taste receptors and (2) mimicking natural chemical messengers which attract predators to their prey.

Boesch (1973) cited the unpublished work of Todd and Atena (Woods Hole Oceanographic Institution, Chemotaxis Group). They worked with behavior patterns of yellow bullheads, Ictalurus natalis, and found that the fishes' complex, chemically mediated social behavior developed high intensity conflict behavior when exposed to water soluble fractions of Kuwait crude oil. These sublethal effects could possibly affect the full range of fish and other nekton in the southern California borderland area. These organisms would be the epipelagic fish, neritic fish, demersal fish, deep water fish, fish larvae, and nektonic invertebrates.

So far as we have been able to determine, there is no information on the impact of oil on the deep water fauna. Conceivably, these organisms may tend to be more stenotypic than shallow water forms and, therefore, possibly more subject to harm from oil pollution. On the other hand, the deeper water would afford a greater chance of dilution for the oil. Petroleum hydrocarbons are accumulated in marine organisms and although they tend to eventually be depurated, predation of surface organisms or other animals which have accumulated oil could serve as a source for large accumulation of oil into certain of these potentially sensitive deep sea forms.

Whales and dolphins. There are 17 species of whales and dolphins (cetaceans) in the regions being transited by the tanker traffic from Valdez to Long Beach. A description of the movement of these animals is given in Section 2.1.8.1. However, there is very little known about the effects of oil on these animals. Adverse effects of oil on benthic amphipods would decrease the food supplies of the gray whales, and an adverse effect on zooplankton would create patches where the baleen whales would find less food or toxic food. However, these large animals could probably outswim a spill before suffering any sustainable damage unless they remained in an area that was chronically polluted. The open ocean is not expected to become chronically polluted, but Sargent (1970) noted that small cetacea are now rare in the North Sea where heavy ship traffic, oil and gas exploration, and industrial contamination are contributing factors to either North Sea avoidance or death.

There is no direct evidence that any cetacean has died from oil pollution. During the Santa Barbara oil spill, Orr (1969) conducted field observations and accumulated subsequent data. He stated, "A review of recorded dead gray whales found during migration along the California coast during the past 10 years revealed that the incidence of mortality in early 1969 was not unusually high." Orr concluded . . . "that no positive evidence was obtained to show that any gray whales died on their northward migration from the effects of crude oil pollution."

Orr also participated in field studies of wildlife affected by the extensive Golden Gate spill of Bunker C oil that occurred on 18 January 1971. Although he reported massive destruction of birdlife, he recorded no effects on marine mammals, including cetaceans (Orr, 1971).

A potential danger to cetaceans is absorption or adsorption through or on the mucous membrane lining the blow hole distal to the nasal plug. This area remains open near the water surface and may become oiled. The ultimate outcome of oil exposure could be a thin oil film covering the lungs and respiratory passages which has the same effect as pneumonia, including death. This disease has been found in human beings exposed to particulate oil in the air (Norris in USDI, 1975). Because of their great intelligence and mobility one would expect whales and dolphins to avoid contaminated areas. However, gray whales migrated through the Santa Barbara oil spill despite attempts by man to reroute them outside the Channel Islands. It is not known if any whales were harmed or killed as a result.

Cetacean vulnerability to oil pollution is decreased by the fact that they are nearly devoid of hair, to which oil adheres. Also, cetaceans spend more time submerged than other marine mammals, which greatly minimizes their exposure to oil.

Fur seal. The fur seal, Callorhinus ursinus, utilizes both blubber and fur for insulation. When the fur is soiled or matted by contamination with crude oil, it loses its insulative ability and the blubber is usually insufficient to enable the fur seal to thermoregulate its body.

Accidental exposure of a less than year-old fur seal on the Oregon coast in 1959 led to the animal's being brought to the Depoe Bay Aquarium. It was very thin and weak, virtually covered with oil. Solvents were used under the direction of a veterinarian to remove the oil and the cleaned seal was washed with soap and water. At first it would not eat, so it was force fed. The animal recovered completely and was, in 1971, still on exhibit in the aquarium (pers. comm. Kendon, Fish and Wildlife Service, from W. Kukaska, 1971 [in USDI, 1972]). The presence of petroleum did not damage the seal permanently. It may also be inferred that the presence of a large amount of oil on the animal interfered with the animal's ability to obtain or deal with food, and it would have died from a combination of starvation and exposure if it had not been rescued (USDI, 1972).

Also, according to the Department of the Interior (1972), of the 3,769 seals taken during pelagic sealing studies of the Marine Mammal Biological Laboratory, Seattle during the 1964-71 seasons, one was observed to have had "half the belly matted with grease" (Fiscus and Kagimura, 1967). Among 107 fur seals taken at sea in May, 1969 off Washington and British Columbia, 12 (11 percent) were contaminated with oil. Of those, eight were taken off the Strait of Juan de Fuca. This indicates that fur seals enter busy shipping lanes and may become contaminated with oil (pers. comm. Kenyon, Fish, Wildlife Service, from MacAskie, 1971). Among hundereds of thousands of fur seals harvested on the Pribilow Islands breeding grounds, not one seal having oil on its pelage was recorded. One dead fur seal less than one year old, which was found on a Washington beach, was brought to the Marine Mammal Biological Laboratory in 1948. An area of about one-fifth of its body surface was heavily matted with crude oil. The apparent cause of death was starvation. Three conclusions are indicated:

1. In most open sea areas where fur seals are found in migration, they infrequently come into contact with petroleum products, although, when they enter busy shipping lanes, oil contamination may occur.

2. The absence of seals contaminated with oil on the breeding grounds suggests that either contaminated animals do not survive to return to the grounds or that none become contaminated during migration or that they become clean en route.

3. Information on seal mortality due to any cause is severely limited because fur seals usually occur well offshore. The body is of greater specific gravity than water, and the dead animals sink and thus would rarely be found on beaches.

Fur seals are found in Prince William Sound and, in the winter, even in Port Valdez where they feed on herring. However, the largest Alaskan populations and hauling areas of fur seals are 200 miles southeast and 150 miles southwest of the proposed tanker route. These seals are also concentrated along the Washington coast within 30 miles of the Strait of Juan de Fuca and occasionally in Puget Sound. SOHIO tankers will pass within about 30 miles of the Farallon Islands National Seashore (off San Francisco) where another population hauls out. From the Farallon Islands south to the Channel Islands, fur seals are relatively abundant within 10 to 15 miles of shore between the months of January and May. Also, more than 1,000 fur seals breed on San Miguel Islands, where the tankers will pass within 20 miles.

It is apparent that fur seals could be severely impacted in the event of a large spill. The proximity of the tankers to large breeding areas (San Miguel Island, Channel Islands, California coast) presents the highest risk areas. Large herds of fur seals used to live on the Channel Islands, but were exterminated by hunters in the last century. These beautiful and valuable creatures have only recently reestablished themselves in significant numbers.

Elephant seal. LeBoeuf (1971) described the results of a study of northern elephant seals, Mirorunga augusteroris, on San Miguel Island, California, made in March, 1969 shortly after the Santa Barbara oil spill. On 25 March 1969, this group tagged 58 weaned pups and 5 yearlings that had at least 75 percent of their bodies covered with a mixture of oil, mud, and sand. As a control, they also tagged on the same day an equal number of clean pups on an adjacent beach that was free of oil. In a period of 1 to 15 months after the animals were marked, a total of 25 (40 percent) of the animals that were oiled and 15 (25 percent) of the control group were reported (USDI, 1975). LeBoeuf (1971) concluded that, "these data support the conclusion that the crude oil which coated many weaned elephant seals at San Miguel in March and April, 1969 had no significant immediate or long-term (1 to 15 months) deleterious effects on their health." Had the rookery been contaminated earlier in the season when females were nursing, pups might have ingested the crude oil and more serious consequences might have ensued. "Studies of tissues from dead marine mammals found on San Miguel Island after the oil spill failed to show any evidence that they might have died because of oil" (Simpson and Gilmarten, 1970).

Elephant seals are found in Alaska, the Pacific northwest, including Puget Sound, and in California. The three California populations, located at the Farallon Islands, Ana Nuevo Point beach, and San Miguel Island, are all close to the tanker route.

California and Steller's sea lions. Very little is known about the effects of oil in the sea lions, Zalophus californianus and Eumetopias jubatus. Of the examined California sea lions and other seals that were found dead or dying on the beaches of southern California, none has had petroleum products in its body (pers. comm. Kenyon, U.S. Fish and Wildlife Service, from Grinar, 1971). However, eye damage or irritation to seals has been reported by Nelson Smith (1973). He noted that ". . . after the Arrow spill in Nova Scotia, young gray seals were found blundering about in woods, a half-mile from shore, unable to find their way back because of oil around their eyes and nostrils (Pearce, 1970) and a blind female, now in a Cornish seal sanctuary, was rescued in a fuel oil spillage some years ago."

Smith and Geraci (1974) found that eye damage was the most serious physical impairment in their studies. They concluded that it was reasonable to expect that continued exposure to oil could result in severe, possibly permanent eye disorders. Severity of eye damage from oil would be a function of exposure time (USDI, 1976).

Sea lions, as well as all marine mammals, are likely to show this sensitivity of the eyes. Contamination of breeding rookeries that are frequented by sea lions would be very detrimental if it occurred near pupping season (June and July). Both adults and young would be in danger of becoming oiled; young also would be susceptible to ingestion of oil while nursing.

In Alaska, locations where Steller's sea lions are susceptible to oiling include the following:

Kenai peninsula

Chiswell Islands (4,800)
Otter Island of the Pye Islands (6,000)

Prince William Sound

Hinchinbrook Island, Seal Rocks
Port Valdez

For more detailed information, the reader is referred to a report by K.W. Pritcher, 1975, Distribution and Abundance of Sea Otters, Steller Sea Lions and Harbor Seals in Prince William Sound, Alaska Department of Fish and Game Report.

California sea lions are found in summer and Steller's in winter on the offshore rocks of the Washington and Oregon coast and in Puget Sound. Sea lions would possibly be affected in these areas should an alternate port be used for repairs.

In California, Steller's sea lions are susceptible to oiling in the following locations:

San Francisco area (haul out areas)

Seal Rocks off San Francisco
Farallon Islands (breeding, rookery)
Arch Rock
Gull Rock
Bodega Rock
Abbotts Lagoon area
Point Reyes headlands
Double Point south
Bolinas Point
Needle Rock
Point San Pedro
Sail Rock
Rocks off Miramentes Point
Mouth of San Gregoria Creek
Rocks off Pescadaro Point
Rocks off Pigeon Point
Ana Nuevo Island
Table Rock
San Miguel Island
San Nicholas Island

California sea lions may be found at the following locations:

San Francisco area (haul out areas)

- Point Reyes headlands
- Seal Rocks off San Francisco
- Farallon Islands
- Ana Nuevo Island
- Table Rock
- Needle Rock
- Rocks off Monterey Peninsula

Big Sur area

- Point Lobos Rock
- Yankee Point Rocks
- Point Sur Rocks
- Point Buchon Rock
- Lion Rock
- Pecho Rock
- Point Sal

Southern California and Channel Islands

- San Miguel Island
- Santa Rosa Island
- Santa Cruz Island
- San Nicholas Island
- Santa Barbara Island
- Santa Catalina Island
- San Clemente Island

Seabirds. Several incidents of seabird mortality in the oceans have been described (Bourne, 1968a, 1968b, 1969 and 1970; Bourne and Devlin, 1969 and 1971). Tanis and Marzer Bruyns (1968 as cited by Nelson Smith, 1973) calculated that the total annual loss of seabirds from oil pollution in the

North Atlantic and North Sea was about 150,000 to 450,000 individuals. Perhaps, the most widely publicized oil spill was that of the tanker Torrey Canyon which reportedly killed a minimum of 7,854 birds and may have killed 40,000 to 100,000 birds (Bourne, 1970).

In 1972, an oil slick caused by the wrecked tanker Arrow and oil barge Irving Whale killed at least 12,000 birds off the Newfoundland coast (Brown et al., 1973). According to the Smithsonian Institution's Center for Short-Lived Phenomena, 15,000 to 25,000 oiled eider ducks came ashore on Wadden Islands, Netherlands, in February, 1969 (Aldrich, 1970). Burnett and Snyder (1954) reported the wintering population of common eiders off the Massachusetts coast declined from 500,000 in 1952 to 150,000 in 1953 as a result of oil pollution.

Because of differences in seasonal distribution, behavior, and foraging habits, all coastal and pelagic birds in the ocean and along the coast are not equally vulnerable to oiling. Most vulnerable to oil pollution are the marine species which forage by diving, pursuit plunging, or surface seizing. Examples are alcids, auks and relatives; and dythyinae, sea ducks (Brown, 1973; Aldrich, 1970 and 1972; Burnett and Snyder, 1954; Dennis, 1959; Richardson, 1956; Wallace, 1971; Tuck, 1960). Some species react to alarm stimuli by diving. Investigators in the United Kingdom observed a definite species composition of oiled birds. Larids (seagulls and terns) comprised about one-third, and waterfowl and alcids (auks, murres, etc.) comprised about two-thirds of the total dead birds on coastal beaches.

Diving or swimming species are particularly vulnerable because they react to floating oil by diving (as opposed to flying up out of the contaminated area) and quickly become totally oiled (Bourne, 1968b and 1970). In small patches of oil, swimming or diving bird species could avoid coming into contact with the oil, but not in the case of large slicks. Diving is a poor escape mechanism for large oil slicks. The above foraging behaviors are significant because they increase the birds' chances of becoming oiled.

There are more than 60 species of marine birds that exhibit diving type behavior. Some of these are particularly abundant in the north Gulf of Alaska coast region; e.g., alcids are present in numbers exceeding 1.4 million birds (USDI, 1976).

More than 50 species of marine-oriented birds in the north Gulf of Alaska coastal region roost on water. Those bird species which roost on the water at night are more vulnerable to oiling because of their increased exposure and their increased chance of coming upon an oil slick unintentionally. The most abundant marine-roosting birds in the northern Gulf of Alaska are: loons (170,000 in May), shearwaters (reaching nearly 50 million birds in April), petrels (more than 200,000 in June), northern phalaropes (642,000 in May), several species of larids (more than 1.1 million in May) and alcids (reaching 1.4 million in April) (USDI, 1976).

The numbers of individuals of a given species affected by an oil spill depends on their total numbers and distribution as well as the extent of the spill. A flocking species found in large concentrations in tidal, inshore, or offshore areas would be more likely to suffer greater mortality, than a rare and solitary land-roosting species (Scott 1974). In the northern Gulf of Alaska, more than 40 marine-oriented bird species exhibit flocking behavior. The more abundant flocking species, both in the Gulf of Alaska and offshore Canada and the lower United States, are the several species of larids, alcids, procellariids, waterfowl, and shorebirds. From the standpoint of numbers, the most spectacular flocking bird species are the shearwaters which numbered about 47 million in April, 33 million in May and 2 million in June in the Gulf of Alaska. It should be noted that species as abundant as the shearwaters, while susceptible to greater mortality (e.g., 1 million birds) from oil pollution, may not be impacted in an ecological context as greatly as the less susceptible but less numerous species of birds. Some diving species become flightless during their molt, such as alcids and waterfowl (Tuck, 1961) or do not fly at all because of social bonds with the flightless young (common murre). These and other birds which spend nearly 100 percent of the time on the water are particularly vulnerable to oiling.

Aerial surveys were conducted in June, July, and August of 1974 in the Gulf of Alaska. This was in accordance with the Alaska Native Claims Settlement Act, to determine, in part, the distribution of seabirds, adjacent to the new proposed wildlife refuges. The proposed refuges were offshore of the Barren Islands, Kodiak Rocks, Togial, Yulan Delta, Bering Sea, Chucki Sea, and Arctic Sea. The data are to be used for final selection offshore boundary distances (USDI, 1974d).

The data indicated that the average bird density (all species) generally decreased with greater distances from shore; however, in late summer and fall many birds disperse from breeding colonies to offshore wintering areas. About 95 percent of the birds recorded during the June survey were within 6 miles of the shore. The average density ranged from 6,968 birds/mi² within 1 mile of shore to 14 birds/mi² between 11 and 12 miles from shore. Shearwaters were most numerous between 5 and 6 miles from shore, while alcids, larids and cormorants displayed the greatest affinity for shore during the June surveys.

Many species and family groups discussed above are very mobile in their seasonal distribution. Colonial nesting seabirds would be very vulnerable during the spring and summer while they are concentrated at their breeding rookeries and utilizing pelagic foraging areas in the northern Gulf. Many of the colonial seabirds would also be vulnerable while wintering in offshore areas in the northern Gulf, such as larids and probably some alcids. During spring and fall the northern Gulf is frequented by massive numbers of migrating shorebirds and waterfowl. During summer and winter the Gulf of Alaska is frequented by several species of oceanic birds numbering about 50 million and 1.5 to 3 million, respectively. Large numbers of birds would be vulnerable to oiling in the northern Gulf year-round (USDI, 1976).

Although there are fewer (1.5 million plus) birds occurring in the northern region during winter, oil spills could still inflict severe damage to a sizable population of wintering waterfowl and oceanic seabirds. Many species absent in the north during winter are found in the south off California as mentioned in Section 2.1.8.1. Spills in identified offshore foraging areas would cause severe mortalities. Depending on the frequency of occurrence, a large mortality of seabirds could be a relatively short-term impact as annual recruitment should eventually bring a bird's population back to prespill levels. If large spills occur frequently during the breeding season in certain locations, bird resources could be severely depleted and possibly eliminated. This has happened in certain colonies in the United Kingdom. Contamination of traditional waterfowl concentration areas would probably create a longer-term impact, as hydrocarbons can persist in sediments for several years.

Some spills could be expected to occur in the open ocean as a result of accidents in addition to the spillages of bilges. The history of tanker accidents, both in the ocean and along the coast or in bays and estuaries gives evidence of this possibility. Table 3.1.8.1-1 presents several characteristic spills with the numbers of waterfowl killed by each one.

Table 3.1.8.1-1

Tanker Spill

TANKER	Date	Location	Amount of spill	Mortality
Arrow	Feb 1970	Nova Scotia	11,379 tons Bunker C	12,800 birds, mostly chicks and eiders
Torrey Canyon	Mar 1967	England	100,000 tons Kuwait crude	40,000-100,000 birds
Gerd Maersk	Jan 1955	Elbe River	Unknown	500,000 birds of 19 common species, scoters
Two tankers	18 Jan 1971	San Francisco	800,000 gals crude	41,557 birds, Western grebe 55%, scoters 23%, murres 10%
Tanker Duchess	1968	England	Unknown	50% of Tay Estuary population
Palva	1967	Finland	150 tons crude Russian oil	25% to 33% of local population killed

Source: Brown, 1974; Goethe, 1968.

Bays, estuaries, and coastal areas.

Birds. Many estimates of bird mortalities are made following spills, but it is believed that many of these birds never washed ashore to be counted. Circumstantial evidence suggests that 50 to 90 percent of the birds killed at sea never wash ashore to be counted (Jones et al., 1970; Tanis and Marzer Bruyns, 1968); but rather they sink or are eaten by gulls and fish. Scavenging foxes and gulls quickly remove some dead carcasses, and others are either tossed high on the shore or are buried deep in the sand. Investigation (Hope-Jones et al., 1970) in the United Kingdom banded dead birds and scattered them at sea to obtain an estimate of oiled birds that become beached. Only 20 percent were recovered within a four-month period. They concluded that at least 50 percent of the bird corpses sank within 11 days of being cast to sea. One incident involved a die-off of cormorants off the Farne Islands in 1968; only 25 percent of the total kill was observed, leaving 75 percent of the dead birds undetected (Coulsen et al., 1968). Additionally some birds may either die some distance from the site of oiling or they may be reproductively impaired.

Erickson (1963) noted that oil pollution may serve as an agent of intermittent but continuing attrition, especially on those migrant birds using coastal and offshore waters. Many pollution-caused losses occur during the coldest months when the birds are abundant along the southern coasts and are concentrated on stopover points and wintering grounds.

Losses under these circumstances may be especially important. They may affect birds which have already survived the southward flight and hunting season and have become the remaining breeding stock for the next nesting season.

There are varied accounts of the number of ducks that do come ashore after oil contamination. Unfortunately much of the literature does not quantify the amount of oil these birds are exposed to. However, several of these references are included to give a perspective as to the quantities of birds that may be affected by an oil spill. Birds, predominantly eiders, white-winged scoters, and pigeon guillemots, were found contaminated by oil in Cook Inlet near Homer and Ninilchik in November, 1967. There were at least 250 waterfowl and seabirds contaminated in this case according to one report, (USDI, 1976). But according to Evans (1969), on the seven days between 22 November and 8 December 1968, oil pollution, presumably from an oil ballast, killed an estimated 1,800 to 2,000 seaducks. Volume and source of the oil was unknown. One month earlier, on 5 October 1968, near Homer, Alaska, aerial surveys along both shores of Cook Inlet, between Anchorage and Homer, found many dead or dying guillemots and murres (250 to 350) covered with oil (Anonymous, 1968). The birds apparently do not notice floating oil until they actually come into direct contact with it. According to Bourne's (1968a) observation on an encounter between birds and floating oil, guillemots took no notice of the oil slick until they touched it, then exhibited their usual means of avoiding hazards and dived. Herring gulls and kittiwakes also swam in the oil but rose and flew away (USDI, 1975).

Bourne (1968) stated that the effects of oil on the various species is usually related to their varying behavior patterns. Aerial surveys showed that gulls and terns are unlikely to plunge into oil deliberately, but coastal species, sandpipers and plovers, may paddle over it and squat in it on shore. However, the swimming species are compelled to cope with it.

Once birds become oiled, the immediate effect is upon their plumage. It causes the fine elements of their feathers to adhere together. This breaks down the insulation and water-repellent capacity of the feathers and exposes the bird to the elements (Bourne, 1968b and Clark, 1969 in USDI, 1972).

When the plumage becomes oil-soaked and water-logged, birds lose their buoyancy and ability to fly and dive (Erickson, 1963; Chubb, 1954; USDI, 1972). With the insulation capacity of their plumage reduced, birds must raise their metabolic rate to maintain their temperature. If they are unable to feed, this is practically impossible (McEwan and Koclink, 1973).

Experimentally oiled ducks greatly increase their metabolic rates to compensate for heat loss because of a breakdown in the insulating properties of the plumage. Heavily oiled ducks lose twice the heat of normal ducks (Hartung, 1967). Oiled ducks do not or cannot increase their feeding activity to compensate for the increased energy demands. The duck's fat reserves, if any, are quickly depleted, and the birds suffer from accelerated starvation. Accidental starvation during periods of low termperatures is usually fatal for most water birds. Tuck (1960) claimed that a patch of oil, 1 inch in diameter on the front side of a murre, was sufficient to destroy the insulating air pocket and cause death from exposure to the chilling effects of the sea.

Birds become sick from the ingestion of oil when attempting to preen themselves (Hartung, 1967). Hartung and Hunt (1966) concluded that the toxicity level of polluting oil is a definite factor in the observed bird mortality due to oil pollution. Consequently, an oiled bird dies from toxic effects, starvation, exposure, or a combination thereof. Hartung and Hunt (1966) demonstrated that various industrial oils caused lipid pneumonia, gastrointestinal irritation, fatty livers, and adrenal cortical hyperplasia when fed to ducks in single doses that were regarded to be less than that which may be ingested during preening of oiled plumage. Although toxicity varied among the oils tested, all the oils were more toxic when captive ducks were under stress from crowding and low temperatures.

Stress is unlikely to be directly responsible for the death of oiled birds, but is an important contributing factor (Clark, 1969). All the combined effects of cold, starvation, toxic effects of oil, disturbance, internal injury, and presumably fright, combine to cause acute stress. The birds' resistance to secondary infections and the toxic effects of oil is reduced, often beyond the threshold of recovery. Birds under stress are also more vulnerable to predation than healthy birds.

Some water birds that become contaminated with nonlethal doses of petroleum during the breeding season are not likely to contribute to annual production. Hartung (1967) found that ducks that had been fed small doses of relatively nontoxic lubricating oil stopped laying for about two weeks, while "control" ducks continued to lay normally. Such disruption in nesting in the higher latitudes where the growing season is short, is sufficient to cause complete nesting failure among brant (Barry, 1962), geese (Ryder, 1967) and probably other birds. The viability of embryos is greatly reduced when the eggshell becomes smeared with oil from the contaminated plumage of the female. Hartung (1965) recorded only 21 percent hatching success among a group of mallard eggs that had been lightly coated with medicinal mineral oil, but 80 percent for unoiled mallard eggs. Experimentally, oiled female mallards continued incubating their unviable eggs for longer than normal periods (Hartung 1965). The prolonged and unsuccessful incubation period, could prevent other unoiled ducks from nesting or attempting to renest.

According to U.S. Department of the Interior (1975), renesting by many species of waterfowl is seldom either attempted or successful in the more northern latitudes. The success or failure of the first nesting attempt usually determines the outcome of that year's production.

The long-term damage to bird habitat from chronic oil pollution at sea may exceed that caused by irregularly occurring major spills. Murphy (1971) summarized the accumulating evidence which suggests that discharged oil may not degrade as rapidly and completely as previously assumed. He argued that many harmful hydrocarbons, such as the carcinogenic ones, may persist in the marine environment and exert cumulative effects. According to Erickson (1963):

Migratory birds are indirectly affected by deposits of oil which reduce the available food supply of both plant and animal matter on the bottom, in shallow water, or along the shore. Various elements in the food chains are eliminated by chemical and physical properties of the oil, or items of the diet may be made unavailable by being overlaid or imbedded in tarry materials. The use of important feeding grounds has declined greatly after pollution by oil, probably because fouling of the habitat had reduced the attractiveness of the areas. Many shorebirds which rely upon the intertidal zones for feeding may find them completely blanketed with oil.

According to U.S. Department of the Interior (1972), groups believed to be the most susceptible to contamination by oil along the Sea Leg between Valdez and Long Beach are: murres, guillemots, auklets, murrelets, puffins, cormorants, loons, grebes, eiders, scoters, and oldsquaws. Shearwaters, fulmars, albatrosses, petrels, gulls, terns, shorebirds, and some ducks and geese are also vulnerable to contamination at sea, but less so than divers.

Some bird species are more vulnerable to oil than others as indicated by records of casualties (Clark and Kennedy, 1968; Bourne, 1968b; Wallace, 1971) which show close relationships between the amount of time that a species spends in the water and the frequency of contamination (Erickson, 1963). In Great Britain (Bourne and Devlin, 1969) oil has had its main impact on a limited number of diving birds which are already known to be decreasing, especially the auks and common scoter. Although a considerable number of gulls are affected, their mortality rate appears to be much lower, presumably because they seldom become as soaked with oil as alcids and because they do not stay on the water to get chilled afterward.

The following analysis is based on the judgment of the analysis staff for this document and on where spills may occur in the event of an accident.

Port Valdez -- A serious spill in Port Valdez would have a direct impact upon the following birds as discussed in this section:

Barrow's goldeneye
Common eiders
King eiders
Buffleheads
Old squaw
Common merganser
Red-breasted merganser
Greater scaup (winter)
Mallards

Pintail
American widgeon
Gadwall
Green-winged teal
Shoveller
Bald eagles (on salmon streams)
Marbled murrelet
Kittlitz's murrelet

Prince William Sound -- A spill in Prince William Sound would adversely affect numerous birds. The numbers of birds affected would depend upon the size of the spill, the weather, and the season of the year. Numbers refer to known populations as described in Section 2.1.8.1.1, Birds.

It is estimated that there are 800,000 birds in the Sound in the spring. Potentially affected birds could be as follows:

3,500 alcids
10,000 tufted/horned puffs
Bonaparte's gulls (summer)
Grebes
Eagles
White-fronted geese
Trumpter swans
3,000 common murres
Sabine's gulls (spring migration)
Loons in migration
Hawks
Cranes
Snow geese

Breeding birds	Nonbreeding birds
Seaducks	Scoters
Cormorants	Black brant
Gulls	Arctic tern
Kittiwakes	Aleutian tern
Alcids	
Canada geese	

Major Alaskan seabird breeding colonies along the route are shown on Maps 2 and 4, Attachment 2. The largest colonies are located on Martin Island (37,000), Egg Island (20,000), Wingham Island (22,000), Porpoise Rock (25,000), and Boswell Rock (10,500). The most abundant nesting species are black-legged kittiwake (60,000), glaucous-winged gull (approx. 28,000), tufted puffin (approx. 19,000), murres (approx. 10,000), and horned puffin (approx. 2,000), with well over 120,000 marine-oriented birds likely to utilize these breeding areas throughout the year. The impact of an oil spill will depend significantly on its proximity to these various colonies and the time of occurrence. A summertime spill adjacent to Martin Island would likely result in maximum mortalities (Tetra Tech, 1977). In general, mortalities incurred for diving birds might approach 50 percent, as determined for the Santa Barbara oil spill (Connell, 1971).

The following birds are vulnerable to a spill in the Copper River Delta, should one move in from the direction of the Gulf of Alaska:

Migrating loons
Grebes
Waterfowl
Hawks
Eagles
Cranes
Shorebirds
Whistling swans
Bonaparte's gulls
Bald eagles

The following birds are especially vulnerable along the Hinchinbrook and Montague islands should a spill occur there:

Glaucous-winged gulls
Kittiwakes
Alcids
Black brant

The following birds are vulnerable to a spill in the Blything Sound and Kenai Peninsula should a spill be washed into this area by the Alaskan current:

Black-legged kittiwakes
Tufted puffins
Other alcids
Glaucous-winged gulls
Cormorants

From Montague Island to the south tip of the Kenai Peninsula there are 40 colonies of birds. The Chisell Islands, Harris Peninsula, and Acalik Peninsula host over 500,000 nesting seabirds (Wohl, BLM 1976) with Granite Cape, Beehive Island and other small islands southeast of Beehive each having well over 100 birds each. The Rye Island group has more than 15 colonies in three islands with more than 150,000 birds; one colony alone on the outer island has 100,000 birds. This same distribution of birds is found on Kodiak Island. For further information on Kodiak Island, see USDI, 1976b.

The following birds use as their home the Gulf of Alaska and would be vulnerable to a spill in that area (population numbers are explained in Section 2.1.8.1):

Albatrosses	(30,000)
Storm petrels and phalaropes	(715,000)
Gulls, terns and jaegers	(50,000)
Alcids	(4,000,000)
Migrating black brant geese	(150,000)
migrating Canada geese	(250,000)
Lesser snow geese	(250,000)

The following birds are the major species vulnerable to an oil spill along the Sea Leg:

Shearwaters
Storm petrels
Jaegers
Alcids
Sabine's gulls
Red phalaropes
Albatrosses
Fulmars

The following birds are vulnerable to a spill at Bodega Harbor, California, should a spill occur within 40 miles of the coast:

Gulls (May, July, and August)
Grebes (May, July, and August)
Waterfowl (May, July, and August)
Cormorants (May, July, and August)
Terns (May, July, August)
Loons (May, July, and August)
Coots (May, July, and August)
Pelicans (May, July, and August)
Ospreys (May, July, and August)
Herons (May, July, and August)
Brown pelicans (year-round)
White pelicans (summer)
Brandt's cormorant (rocky outer coast)
Pelagic cormorant (rocky outer coast)
Great blue herons (salt marsh)

The following species would be vulnerable to an oil spill, should one occur within 40 miles of the coast at Bolinas Lagoon:

Plovers
Godwits
Willets
Turnstones
Snipes
Curlews
Avocets
Dowitchers
Herons
Egrets
Loons
Grebes
Pelicans
Cormorants
Kingfishers

The following birds would be vulnerable to an oil spill, should one occur within 40 miles of the coast near San Francisco Bay:

Avocets
Stilts
Godwits
Canvasbacks (one-half of all those along the Pacific flyway)

Also, the 250,000 seabirds at Farallon Islands National Seashore:

Leach's petrel (1,000 to 2,000)
Ashy petrel (8,000)
Double-crested cormorant (100)
Brandt's cormorant (7,000)
Pelagic cormorant (2,000)
Black oyster catcher (25)
Western gull (30,500)
Common murre (50,000)
Pigeon guillemot (2,000)
Cassins, breeding (105,000)
Cassins, nonbreeding (25,000)
Tufted puffin (120)

Bird rookeries at the following rocks (Bell, 1973) in the San Francisco area would also be adversely affected in the event of an oil spill:

Bodega Head rocks
Point Reyes rocks
Double Point north
Double Point south
Farallon Islands
Devil's Slide
Bird and Seal Rocks (Monterey Peninsula)
Pt. Lobos (Bird Island)

The following birds would be adversely affected should a large oil spill occur within 40 miles of the coast at Elkhorn Slough. At Elkhorn Slough there are more species of shorebirds than any other group. There were 20,000 water associated birds as of October, 1967:

Sandpipers
Plovers
Dowitchers
Willets
Curlews
Godwits
Avocets
Phalaropes
Herons (salt marsh)
Egrets (salt marsh)
Grebes (open water divers)
Loons (open water divers)
Cormorants (open water divers)

Waterfowl (resting and feeding during migration):

Mallard
Pintail
Green-winged teal
Cinnamon teal
Shoveller
Greater, lesser scaup
White-winged and surf scoters
Ruddy ducks
American coot
Geese (white-fronted)
Canada geese
Snow geese
Ross's goose
Black brant

Should an oil spill occur within 40 miles of the coast near Morro Bay and the Big Sur area, the following birds would be adversely affected; On 7 February 1967 there were 25,000 birds in this area:

Marbled godwits
Willets
Sandpipers, least/western
Curlews
Dunlin
Dowitchers
Sanderlings
Great blue heron
California black rail
10 species of gulls
(Heerman's, California, western, ring-billed)

6 species of tern

Black-crowned night heron
Snowy egret
Common egret
Pintail
Lesser scaup
Widgeon
Ruddy ducks
Bufflehead
American peregrine falcon

The following marine bird rookeries are in this area, and would be adversely affected in time of a spill:

Castle Rock
Hurricane Point
Squire Back Rock
Plaskett Rock
Cape San Martin
White Rock
Piedras Blancas Rocks
Pt. Buchan
Lion Rock
Pecko Rock

White Rock
Piedras Blancas Rocks
Pt. Buchan
Lion Rock
Pecko Rock

The following birds would be adversely affected in case of an oil spill if it occurred along the coast between Point Conception and Long Beach. For a complete list of the birds in the ocean, along the coast, the Channel Islands and in the salt marshes and estuaries of southern California, see Appendix Tables 2.1.8.1-1(1), (2), and (3).

Gulls
Shorebirds
Waterfowl
Loons and grebes
Cormorants
Pelicans (including the Endangered brown pelican)
Peregrine falcon (Endangered)
California least tern (Endangered)
Light-footed clapper rail (Endangered)

In summary, when coated with crude oil, birds lose their buoyancy and ability to fly. They lose their insulative air layer and may die of exposure. Trying to increase their internal temperature, they increase their rate of metabolism, use up fatty deposits and may die of accelerated starvation.

Birds suffer from internal toxicities when oil is ingested. Internal contamination by industrial oils has resulted in lipid pneumonia, gastro-intestinal irritation, fatty liners, and adrenal cortical hyperplasma. Crude oils may affect the birds in a similarly adverse manner.

Some water birds which become contaminated with nonlethal doses of petroleum during the breeding season are not likely to contribute to annual production. In higher latitudes with a short breeding season this is especially serious.

Migrating birds are adversely affected if their food supply of plants and benthic animals is destroyed by an oil spill along their feeding or nursery grounds.

Eggs covered with oil are less likely to hatch than unoiled eggs.

These impacts would occur as a result of oil contamination from accidents and collisions of the tankers, loading and unloading, and the ballast of ships if changed at sea.

Rehabilitation of oiled birds -- Aldrich (1970) reviewed the problem of rehabilitation of oiled birds and reached the following conclusions:

> Oil of varying sorts can be cleaned from the plumage of birds with several kinds of cleaners, but so far there is no convincing evidence that the natural water repelling qualities can be restored to the cleaned feathers by known means. The only cases where birds cleaned of oil have apparently been successfully returned to the wild are those in which the birds had been held in captivity through the annual molt.
>
> Curing oiled birds of the original toxic effects of ingested oil and of the ills developing from rehabilitation is basic to the success of any salvage effort and must be perfected for each species concerned.

> Aside from the special pathological problems resulting from the initial poisoning and exposure, soiling of the feathers by oil, and the problem of restoring waterproofing to the plumage, the problems involved in the care of cleaned oiled birds are largely avicultural. Their difficulty depends on the reactions of different species of birds to captive conditions and the knowledge of the aviculturist about the requirements of any one species in captivity.

So much uncertainty surrounded the estimation of success in "rehabilitating" birds from the Torrey Canyon disaster that Clark and Kennedy (1971) restricted their evaluation of treatments up to the time of release, even though this gave an "over-optimistic" view of the situation. Treatment methods were generally unsuccessful, with only 450 of at least 7,848 oiled birds, for which records were maintained, surviving one month following treatment, for an initial survival rate of 5.7 percent. Bourne (1970) calculated that only 0.2 to 0.4 percent survived to be returned to the sea where at least 25 percent were soon found dead under conditions where the recovery rate was poor. He concluded that it was unlikely that the rehabilitation rate reached 0.25 percent and it could well have been much less.

The small numbers of oiled birds surviving the rehabilitation efforts following the collision of the Arizona Standard with the Oregon Standard in San Francisco Bay in 1971 suggests that little progress has been made with methods since the Torrey Canyon spill in 1967. Of the estimated 7,000 dead and dying birds that were brought to cleaning stations in mid-January, 1971, some 200 were still alive in late May and more than 50 had been released (Wallace, 1971) with only one-fifth to one-quarter of those being treated surviving more than 10 days (Lassen, 1971).

The International Bird Rescue and Research Center (IBRRC) in Berkeley, California, has recently completed a manual for the American Petroleum Institute which discusses techniques for cleaning various kinds of birds. These more recent techniques are reported to be much more successful than previous experiences in rehabilitating oiled birds.

Harbor seal. Two dead harbor seals, Phoca vitulina, heavily coated with crude oil, have been reported; one was found in Tacoma Harbor and the other in Tacoma Narrows, Puget Sound in about 1952. It was presumed that both had died because of the oil on their bodies but no positive determination was made. The source of the oil was ascribed to intentional ship discharge but no definite linkages were established.

A yearling harbor seal was found completely covered with oil in about 1952 and was brought from a beach in Tacoma Harbor to the Tacoma Aquarium. It was thin and weak. The seal was carefully cleaned and with care and feeding the seal returned to normal health (pers. comm., Brosseau to Kenyon, 1971 [in USDI, 1972]).

No harbor seals were observed with crude oil on their bodies during a 1965 to 1971 study of west colony on Gertrude Island in Puget Sound (pers. comm., K.W. Kenyon, U.S. Fish and Wildlife Service, from Newby, 1971, ibid).

The conclusions indicated from these harbor seal observations are similar to those for fur seals:

1. Oil covering the body may interfere with normal habits and lead to starvation.

2. Petroleum products do not damage the seal if carefully removed.

3. In an observed colony, no seals were found with oil either because of no contact with oil, or failure to survive such contact.

Contamination of breeding rookeries that are frequented by harbor seals will also be very detrimental if it occurs during the pupping season (June, July), both because of the danger of ingestion of oil by the nursing young and because the oiling might trigger the abandonment of the rookery. Since pinniped rookery mortality is density dependent, abandonment of a rookery area because of oiling would likely force animals into an already crowded rookery area or an adjacent area to the rookery which has less favorable habitat conditions (USDI, 1976). This would raise mortality rates of young seals. Rookery abandonment from oil contamination would be expected to last for at least one year and possibly longer depending on the location, extent of oiling, and providing there are not successive oilings of the rookery. The potential then exists for a decrease in the breeding population of the contaminated region. The significance of this impact would depend upon the time period, extent of the contamination and number of oilings. Should the rookery recover over a period of several years, the potential exists for a repopulation of the area.

The following areas in Alaska and California are known rookeries for the harbor seal. A spill in any one of these areas would create a scenario in which the preceding impacts would be seen:

Kenai Peninsula (Cape Puget to Dangerous Cape)

Aialik Bay (500+)
Harris Bay (500+)
Nuka Bay (500+)

Prince William Sound

Seal Rocks
Port Valdez (For more detailed information the reader is referred to a report by K. W. Pritcher, 1975, Distribution and Abundance of Sea Otters, Steller Sea Lions and Harbor Seals in Prince William Sound, Alaska Department of Fish and Game Report.)

Repair port area

- Puget Sound
- Inside mouth of Columbia River, 30 to 40 miles
- Along coastal rocks of Washington and Oregon

San Francisco area

- Rocks off Carnet
- McClures Beach
- Point Reyes headlands
- Double Point north (breeding)
- Double Point south (breeding)
- Rocky Point
- Table Rock
- Needle Rock
- Rocks off Monterey Peninsula
- Seal Rocks off San Francisco
- San Francisco Bay (breeding)
- Farallon Islands (breeding)
- Mussell Rock
- Sail Rock
- Mouth of San Gregoria Creek

Big Sur area

Point Lobos Rocks
Yankee Point Rocks
Castle Rock
Point Sur Rocks
Point Buchon Rocks
Lion Rock
Pecho Rock
Point Sal
Point Arguello Rocks

Southern California

San Miguel Island
Santa Rosa
Santa Cruz Island
San Nicholes Island
Santa Rosa Island
Santa Catalina Island
San Clemente Island

Sea otter. Alaska and California sea otters, Enhydra lutris lutris and E. l. nerius, suffer more seriously from oiling than any of the other marine mammals found in the project area. There are approximately 5,000 sea otters inhabiting the northern Gulf of Alaska concentrated around Montague, Hinchinbrook, and Kayak Islands. Sea otters inhabit shallow coastal waters of less than 50 fathoms, rocky coasts poised to the open oceans, offshore rocks and kelp beds.

The sea otter has no insulating blubber layer as do other marine mammals. Similar only to the fur seal, the sea otter has a coat of fur that provides insulation. However, the sea otter is totally dependent on the air blanket trapped in its fur to keep warm. When the fur coat becomes oiled or matted, the otter loses its insulative layer and dies of exposure.

Accidental exposure of two sea otters to a small but unknown amount of oil (probably diesel) in an experimental holding pool in Amchatka Island resulted in fur matting, progressively severe distress, emergence from the water and death by exposure in several hours (Kenyon, unpublished data). According to the U.S. Department of the Interior (1972), the oil in this case formed a visible sheen, comparable to that sometimes present in harbor areas where gulls appear unaffected by it. Similar or greater petroleum pollution in the marine environment would probably prove fatal to any sea otter that came in contact with it. Since oil pollution has the potential to depress populations of marine benthic invertebrates, oil contamination of shoreline or nearshore areas frequented by sea otters could severely reduce the regional sea otter population through habitat and food resource contamination.

The Marine Mammal Commission in 1976 recommended to the Department of the Interior that the California population of sea otters be designated Threatened under the Endangered Species Act of 1973 because a major oil spill from a tanker in the waters in the vicinity of the range of the sea otter is probably the most serious potential threat to the species (pers. comm., R. J. Hofman, Marine Mammal Commission, 1976). On 14 January 1977, the U. S. Fish and Wildlife Service, pursuant to Section 4 of the Endangered Species Act, formally designated the Southern (or California) Sea Otter as a Threatened species (42 Fed. Reg. 2967.)

Sites for the Alaska sea otter are:

Kenai Peninsula

- Whitby Bay
- Aialik Bay
- Harris Bay
- Nuka Bay
- Chugach Islands

Prince William Sound

Port Valdez (For more detailed information the reader is referred to a report by K. W. Pritcher, 1975, Distribution and Abundance of Sea Otters, Steller Sea Lions and Harbor Seals in Prince William Sound, Alaska Department of Fish and Game Report.)

Washington

Destruction Island to Cape Flattery (10 to 12 in 1975)

Oregon

South of Columbia River off Rogue River

Sites for the California sea otter are:

California

From Santa Cruz on the north to Avila Beach on the south.

Port of Long Beach

Primary impacts of project operations on marine fauna in the port area would result from chronic low-level oil leaks and large occasional oil spills. The impacts of oil on various marine organisms discussed in the preceding section would also apply to those same organisms found in the port area.

The following discussions summarize and relate some of these impacts to specific organisms in the port.

Zooplankton. Direct kill of zooplankton organisms in surface layers could result from an oil spill. Zooplankton would be more vulnerable to an oil spill during their spawning period. If a spill occurred within the harbor, it might have long-term significant effects on distribution and survival powers, because repopulation depends upon local availability. Sublethal effects, such as carcinogenic effects, food chain uptake, chemoreception interference, and decrease in fecundity, are presently unknown but are potentially dangerous.

Benthic invertebrates. Direct destruction of intertidal benthic organisms by suffocation would be the principal effect of oil spills (Chan, 1975). Oil from the Torrey Canyon spill coated and rapidly killed winkles and limpets (Nelson-Smith, 1973). When immersed for various periods of time in Kuwait crude residues (Nelson-Smith, 1973), winkles, Littorina littorea and L. obtusata, had 6 to 100 percent mortality rates, respectively. The small acorn barnacle, Chthamalus fissus, died from coating in the Santa Barbara spill. No effect was noted on acorn barnacles, Balanus glandula, (Straughan, 1971). Benthic organism reproduction and repopulation would be retarded for several months; complete biological recovery could take two to five years.

Damage by oil to the sandy beach communities south of Pier J could be equal to that within the spill area. Beach cleanup operations could cause severe destruction of the local surviving annelid, crustacean, and echinodern populations. In addition to smothering effects, physiological changes, such as reduced fecundity, delayed sexual development, and impaired behavioral patterns that inhibit reproduction, could occur (USDI, 1976).

Adult subtidal organisms are generally less susceptible to direct damage from oil than intertidal organisms. Some species, such as the quahog, Mercenaria mercenaria; the sea anemone, Anthopleurs xanthogrammica; and the polychaete, Capitells capitata, are virtually immune to crude oils. Other species are destroyed at concentrations exceeding 1 mg/l. Tolerance levels for mysids and shrimp range from 18 to 62 ppm depending on the type of crude (Anderson et al., 1974). The planktonic larval stage of many benthic organisms, the life cycle stage most sensitive to pollution, concentrates near the surface. The direct impacts of oil pollution of subtidal filter-feeders generally decrease with increasing depth. The impacts on detritus-feeders might be greater than on filter-feeders because the oil could be buried or could contaminate the food source.

It is evident that certain species are much more tolerant of oil than others, and among these are dominant barnacles and mussels (USDI, 1976).

Fish. Fish mortality as a result of lethal toxicities in the harbor is hard to quantify. The toxic fraction of Prudhoe Bay crude oil, at least for salmon fry, appears to be an unsaturated aromatic hydrocarbon. It kills by altering cell membrane permeability (Morrow, 1974). Fish migrating through an oil spill, therefore, could be poisoned, resulting in at least some mortality.

Extensive mortality in a variety of fish, particularly clupeoids (herrings), occurred when fish were exposed to a crude oil spill of 10,000 tons in Guayanilla Harbor, Puerto Rico (Nat. Acad. of Sciences, 1975). Even so, the literature implies that most adult fish tend to avoid oil spills (USDI, 1975). No adverse effect was noted on northern anchovy in the Santa Barbara spill (Straughan, 1971).

Kills of larvae and eggs could be expected in the harbor, particularly if a spill occurred during the late winter-spring spawning period. Poor hatching success in herring eggs exposed to water-soluble components of Prudhoe Bay crude was noted at 100 ppm (Nat. Mar. Fish. Serv., 1975). Most fish eggs and larvae exist in the uppermost surface layers of the water column. Once in the vicinity of oil slicks, those organisms would remain with the slick because movement of both are influenced by currents. Larvae also do not seem to be able to avoid oil-contaminated water because the chemoreceptors are blocked or destroyed. Larvae and younger stages of floating eggs might thus be injured, causing abnormality and death. Eggs laid in rock crevices in the harbor by the midshipman, cabezon, and lingcod could be particularly affected by oil and its water-soluble fractions. Most larvae hatched in seawater with "oil and oil products" were abnormal and, even at .0001 ml/l, eventually died (Mironov, 1972).

Physical coating by oil can temporarily decrease fish and food supply. Oil reaching rock shore communities would kill at least some attached crustaceans. This would decrease food supplies for seaperch, greenlings, sargo, and juvenile rockfish. If the oil killed large amounts of planktonic copepods, amphipods, and shrimp, reduction of food supply for juvenile kelp bass, California halibut, and rockfish would result. An extensive kill of zooplankton and phytoplankton in the harbor would seriously reduce the anchovies' food supply. A large-scale reduction might damage certain year classes of anchovy or other species (USDI, 1975), particularly if it occurred in the winter or early spring when peak anchovy reproduction takes place in the harbor.

Should the oil sink, as can occur in highly turbid conditions, various forms of benthic life, including polychaetes and siphon feeders, would die. This would reduce food supplies for obligate benthos and benthic feeders, such as flatfish, sargo, and croakers.

Zooplankton feeders in the harbor, such as young croaker and anchovies, might accumulate large quantities of oil; those fish might be eaten by such harbor species as bonito, kelp bass, California halibut, bocaccio, and olive rockfish. Such activity also contributes to tainting.

Assessment of oil damage is not only dependent on immediate kills. Chronic spills are potentially more dangerous. Such spills could decrease fish resources and modify marine ecosystems by eliminating species and decreasing diversity and productivity. Repopulation by displaced species might not be possible because the niche has been filled with more tolerant and possibly less desirable species. Chronic spills might impair reproductive ability through reduced fecundity or delayed ovary development. Impaired behavior could prevent mate location or interfere with homing or timing of spawning. These effects could be especially significant for sport or commercial fish.

Year 2000. An increase in ship traffic increases the hazard of accidental spills and collisions. Chronic spillage of oils or other pollutants could seriously deplete the flora and fauna (Allan Hancock Foundation, 1976). The cumulative biological impacts related to future operations would be largely dependent upon frequency and amount of incremental and catastrophic oil spills. Incremental spills that might occur frequently with ship-to-shore oil transfer operations would probably reduce the species diversity of the marine communities in the area of transfer. The cumulative impacts of catastrophic oil spills also depend upon efficiency and effectiveness of cleanup operations associated with oil spill contingency plans. The possible buildup of crude oil residues on marine habitats resulting from repeated catastrophic spills could be responsible for a general reduction in the biological productivity of the harbor complex.

Fish -- Chronic oil spills would seriously affect the fish. They would be stressed by lethal and sublethal effects and by destruction of food sources in the intertidal and subtidal areas. The enclosed nature of the harbor in year 2000 will make oil cleanup easier. However, during storms or periods of high turbidity, the oil might either emulsify or sink. Either might kill the fish or their food organisms. The extent of damage depends on the toxicity of the prospective oils.

Impact on terrestrial wildlife along the Alaskan and California coast and beaches

Moose, bears, and furbearers all utilize coastal beaches for foraging or transportation and are susceptible to being oiled and/or ingesting oil. Peller (1963, as cited by Nelson-Smith, 1973) and McEwan et al. (1974) recorded the effects of oiling on muskrats. They found that if muskrats were exposed to moderate quantities of oil, it would be doubtful if they could survive under natural conditions and they would be likely to die of exposure. Furbearers might be particularly vulnerable, and populations would move out of the area as forage disappeared. The significance and magnitude of oil contamination on terrestrial wildlife would depend on the location and extent of contaminated beaches and the season of the year.

The impacts of oil upon fauna and flora have been discussed quite thoroughly in Sections 3.1.2.1.2, 3.1.7.1, as well as 3.1.8.1. Only a few additional points need to be reemphasized.

The flora of bays and estuaries can suffer severe impacts from oil spills. Obviously, major floristic changes would profoundly affect bay and marsh fauna as well. For example, death of vegetation can lead to erosion, literally eliminating the habitat of many benthic species. The loss of benthic species then impacts demersal species, many of whom prey upon their benthic neighbors.

Persistence times for oil in marshes and bays is very long, a minimum of 10 years in worm and clam flats (Shenton, 1973). Animals, therefore, would be subject to oil-related stresses for many generations. Resultant losses in fecundity, general vigor, size, and behavioral modifications (Struhsaker, 1976; Korn et al., 1974; Whittle and Blumer, 1970; Nelson-Smith, 1970) would probably result in elimination of many species from the area.

Marshes and bays serve as important nursery grounds for many species of fish. Spawning fishes, eggs, larvae, and fry are all more susceptible to oil impacts than adult nonspawning fishes. The reduction in spawning success and decreased numbers of offspring reaching adulthood would affect many species which spend their adult lives in the ocean.

Bacteria, benthic and planktonic, have as much influence on the distribution of plants and animals in bays and marshes as do temperature, salinity, nutrient concentration, and other physical and chemical factors (Hedgepeth, 1957). They are important as decomposers and as food for other organisms. In Mission Bay, California, for example, aerobic bacteria are more abundant than anaerobic bacteria to a sediment depth of about 23.6 inches (60 centimeters), well below the depth of free oxygen. The presence of oil in the water column and sediments would profoundly affect the bacterial populations, favoring some species, eliminating others. The overall change would alter the marsh or bay significantly and probably deleteriously affect most other organisms.

Terrestrial wildlife and marine-associated birds. Terrestrial wildlife would be insignificantly affected by operation and maintenance activities. Few animal species are located on port terrestrial habitat, and few would be exposed to accidental oil spills.

Marine-associated birds would be slightly affected by increased long-term harbor activity (oil tankers), which would displace birds from the low-intensity use, intensity-use, open-water feeding and resting areas south of Pier J. Greater activity around the perimeters of the Pier J area could restrict use of resting sites by gulls and occasional brown pelicans.

An accidental oil spill in the harbor area has the potential for significantly impacting certain marine-associated bird species, such as diving ducks, (scoters, scaup), grebes, and cormorants, if the spill occurs during the migratory seasons (October to March). Few species are present between April and September to be exposed to oil pollution. Diving sea ducks are especially vulnerable to oil pollution because they are highly gregarious, and a small oil slick can cause very large casualties (Petroleum in the Marine Environment, 1975). Gulls and wading birds are less vulnerable to oiling effects than diving birds because they spend much time on land and would probably avoid the oil slicks. Also, if they are oiled, they are less vulnerable to exposure effects resulting from loss of waterproofing of the feathers.

Marine mammals are uncommon in Long Beach Harbor and, because of their high intelligence, they would most likely avoid any obvious concentrations of oil (Nelson-Smith, 1973).

3.1.8.2 Pipeline route

3.1.8.2.1 Construction

Impacts to wildlife resulting from pipeline construction potentially would occur along approximately 83 miles of the pipeline route from Pier J to Beaumont, California; 31 miles from the Ford Dry Lake in Chuckwalla Valley, California, to the Colorado River; 6 miles from the the Colorado River to the Ehrenberg Pump Station, Arizona; 34 miles beginning about 9 miles inside the Kofa Game Range western boundary and extending to the east; and 71 miles from Jal, New Mexico to Midland, Texas (Figures 2.1.8.2-1, -2, -3).

Wildlife impacts also would occur where there would be new access roads; borrow areas for roadfill and pipe bedding materials; disposal areas for excess soil and other materials removed from the right-of-way; pipe storage areas; construction camps; removal and discharge of water for pipe integrity testing; new pump station sites; and power lines to the pump stations.

Terrestrial

Pipeline construction would generally be confined within a 100-foot right-of-way. Direct impacts on wildlife including mortality of animals which fail to escape vehicles, as well as clearing and/or trenching machinery; destruction of nests and/or dens located within the proposed pipeline right-of-way; displacement of wildlife residing within the proposed pipeline right-of-way at the time of construction; and inhibition and/or halting of reproductive activities as a result of either nest destruction, individual displacement, or physiological stresses created by increased noise levels, human activities, changes in population densities, or other factors.

As was mentioned in Section 2.1.8.2, there is very little wildlife habitat remaining in the urban area between Pier J and Whittier Narrows. Above the Whittier Narrows Dam is the Whittier Narrows Nature Area. Construction activities are not expected to have any significant impact on waterfowl, songbirds, or other wildlife residing in the nature area, as the proposed route is more than one-half mile away. The only possible disturbance would be from construction noise.

Temporary reductions in small mammal population densities in stable communities such as the coastal sage scrub community of San Timoteo Canyon, (Figure 2.1.8.2-1) will undoubtedly occur. The 133 acres that are disturbed by construction activities in this fertile canyon bottom are capable of revegetating in one to two years after construction, at which time small mammal densities would begin increasing toward preconstruction levels within the impacted area. Impacts on terrestrial wildlife in the remainder of the California Coastal Biome will be minimal because of the limited number of habitats suitable for maintaining wildlife populations.

New construction would impact 377 acres from Ford Dry Lake to the Colorado River in the Colorado Desert Biome. This segment of new construction passes through about 264 acres of sandy-gravelly soils which provide excellent reptilian habitat. Although reptiles in southern California are diverse, population densities are often relatively low. As a result, impacts from direct mortality should be minimal. The greatest potential long-term impact on reptiles is the elimination of viable desert habitat. If natural desert drainage patterns are altered, native vegetative composition would also change, leaving some barren areas. Few reptiles are adapted to totally barren areas. Zebra-tailed lizards, fringe-toed lizards, Uma spp. and desert tortoises, are probably the most common reptiles in sparsely vegetated areas of the Colorado Desert.

No significant wildlife impacts would occur in the 2-mile segment of new pipeline construction between the Colorado River and the Ehrenberg Pump Station.

New pipeline construction through the Kofa Game Range (Figure 2.1.8.2-2) would have minimal impact on bighorn sheep. The major desert bighorn sheep concentrations in the Kofa Game Range are to the south of the proposed pipeline route in the Kofa and Castle Dome mountains. Outside of the game range, sheep concentrations are to the north in the Plomosa Mountains and to the west in the Dome Rock Mountains. The only sheep found inside the Kofa Game Range near the proposed route is an occasional migrant moving from one range to the other.

The proposed power-line alignment from the Livingston Pump Station would pass through Copperbottom Pass in the Dome Rock Mountains (Arizona). This area is extensively used by desert bighorn sheep for various seasonal activities. Power-line construction activities from January to April would conflict with the lambing season, and July and August would conflict with sheep utilization of an important water catchment about 100 yards to the north of the existing pipeline right-of-way.

Although distribution of several other big game animals extends across portions of the proposed pipeline route, construction impacts should be minimal because these animals typically exhibit behavioral patterns which include avoidance of high use areas by man. Mule deer for example, would avoid the project area during the construction period, returning after the work is completed. Pronghorn antelope are so scarce and wide ranging in this area that both direct and indirect impacts are likely to be minimal or nonexistent.

Wild burros are found from the Colorado River east through the Kofa Game Range along the existing pipeline route. Any construction impacts on the burros should be minimal as burros are not unduly disturbed by the presence of human beings.

Construction work would also disrupt some terrestrial wildlife habitat which would cause a short-term loss to resident populations, although the disturbed areas will be comparatively small, especially when contrasted with the present uses being made on the land where new construction is proposed. Therefore, overall population losses should be negligible. Some of the area where new construction is proposed has already been heavily subjected to man's activities; for example, in the Colorado Desert the distance from Ford Dry Lake (Riverside County) to the Colorado River (31 miles, or 377 acres) would be impacted by a temporary 100-foot construction right-of-way. However, along this 31-mile stretch 12 miles of the right-of-way is through an area open to off-road vehicles where significant environmental impacts are already evident. Further, approximately 5 miles are over land that has been converted to agricultural uses.

Losses in the vertebrate population of burrowing forms of amphibians and reptiles also would result from direct distruption during the excavation process. Killing of individual animals or destruction of their burrows could affect such animals as aestivating spadefoot toads and the banded sand snakes. Excavation would impact burrowing rodents in the same manner. Any such direct impact would be short-term and insignificant since the number of individuals lost would be very low, even within the immediate area. These losses are even more insignificant when their rapid reproduction potential is taken into consideration. This would not be true for those species that are under special protection because of their limited distributions or numbers such as the Stephens kangaroo rat or Yuma clapper rail.

Impacts resulting from habitat alteration also would accrue to the numerous other species of reptiles, birds, and mammals which utilize the area. Pipeline construction would cause some loss of nesting sites for birds, forage for large mammals, and available habitat for all species. This could cause a small population loss to species of reptiles and to territorial species of birds. However, large birds such as raptors, and large mammals, such as deer, desert bighorn sheep and coyotes, should not be seriously affected by this small loss of available habitat.

The cleared right-of-way would interfere with the daily movement of some species, particularly small rodents, but it is likely to act as only a temporary barrier. The increased dust, noise, and vehicular traffic associated with pipeline construction may cause temporary behavioral changes among some species, resulting in decreased breeding success or temporary abandonment of the area of pipeline construction. In this manner, pipeline construction would impact an area larger than the right-of-way, but this impact would affect at most a single year's breeding activity and involve only a minute fraction of each habitat type traversed by the proposed project. Increased vehicular traffic along the construction route would also result in increased loss of wildlife from road kills, especially among snakes, skunks, jackrabbits, and small rodents whose home ranges would be transected by the right-of-way and access roads.

Blasting along the right-of-way would frighten some wildlife and result in the loss of some ground-dwelling species. Blasting also could cause some decreased nesting success or permanent relocation of nesting sites of birds. Since extensive blasting activities are not anticipated, impacts would be minimal.

Between Jal, New Mexico, and Midland, Texas, there is a possibility of encountering black-tailed prairie dog colonies. Intrusion on prairie dog colonies larger than 10 to 15 acres could have an impact on the habitat requirements of the Endangered black-footed ferret, which could be a resident of the region. The last official sighting of a ferret in the Texas Panhandle occurred in 1971, near Dalhart (U.S. Fish and Wildlife Service, 1976, pers. comm.). However, the nocturnal activity of this endangered species prevents easy observation. Casual sightings, even in areas where ferrets are known to exist, are rare.

The invertebrate fauna would be the group of animals most affected by new construction activities as the invertebrates far outnumber any other wildlife forms, but because of their large numbers and high reproductive rate, the long-term impact on invertebrates is likely to be minimal.

No wildlife impacts have been identified from the 2 miles of proposed new construction at Guadalupe Pass, Texas.

Aquatic

When constructing across the major rivers, clearing of some riparian vegetation, substrate disruption, and temporarily increased siltation pose impacts to aquatic environments. Impacts should be minor and short-term since construction in such areas would be of short duration. For example, construction time for the Colorado River crossing estimated at about 18 days is the longest time required for any of the river crossings. New construction along the proposed pipeline route involves few aquatic environments. New construction would be necessary along the Los Angeles and Santa Ana rivers and for a crossing on the San Gabriel and Colorado rivers in southern California. The Pecos River in New Mexico would also require the construction of a crossing. Other major rivers of concern, although not subject to new construction, are the San Pedro and Gila rivers, and the Rio

Grande. The river crossing of greatest significance is that for the Colorado; it involves new construction under the river.

The primary direct impact to those river crossings requiring new construction would be disruption of existing populations of aquatic biota and diminished reproductive success of benthic invertebrates and fishes. The benthic community (including rooted vegetation) would be disrupted during construction within the proposed pipeline route and downstream for variable distances as a result of temporarily increased sedimentation. Increased stream sediment load would result in reduced primary productivity for a limited distance downstream of the construction site. In the Colorado River, for example, excavation and replacement of a minimum of 34,000 cubic yards of river bottom sediments would increase the turbidity level. At velocities of 1 to 5 miles per hour, it can be assumed that all unconfined excavated material up to 1 inch in diameter would move downstream (Bennett, 1939). Imperial Dam is about 70 miles downstream from the crossing and would effectively retain the bulk of any sediments moved that far (Figure 2.1.8.2-4).

Most mobile aquatic organisms would vacate the proposed right-of-way during construction activities. Although a reduction in reproductive success of these organisms is expected, the high reproductive capacities of most aquatic organisms, the short period of instream construction, and the limited downstream area affected should minimize effects on entire aquatic systems. After one or more periods of rapid water level fluctuation, bottom silt load resulting from construction would be dissipated and downstream areas would again become available habitat.

The Colorado River crossing (Figure 2.1.8.2-4) would be laid under the river below the scour depth and enclosed in 4 inches of concrete casing. Invertebrates associated within the lower Colorado River system below the proposed pipeline crossing site would be affected by short-term increases in suspended materials. With an estimated construction time of 18 days, and allowing one to two weeks after the pipe has been laid for the turbidity level to stabilize to ambient conditions, aquatic organisms would be subjected to increased sediment levels for approximately four to five weeks. The presence of suspended sediments in the system would be damaging to some macroscopic benthic organisms through abrasive action. Molluscs can counteract high suspended-particle levels by producing mucous which acts as a protective barrier and carries suspended material away from the organism's body. When suspended-particle levels are too high, some invertebrates reduce water pumping rates for feeding purposes, thereby reducing food uptake (Oschwald, 1972). In addition, excessive levels of suspended materials may interfere with gas exchange by clogging or damaging the delicate membranes of gill filament structures (Livesey et al., 1971; Oschwald, 1972).

Increased levels of suspended materials would increase turbidity, reducing the amount of light transmitted through water (Stall, 1972). Excessive reduction in light penetration at lower levels in the water might cause changes in behavioral patterns of some filter-feeding plankton and sight-feeding fishes because high turbidities reduce the visibility of available food (Oschwald, 1972).

Introduced game fishes are either adapted to, or not adversely affected by warm turbid waters because their native habitats, such as the Mississippi River basin, are warm and turbid. Increased stream turbidity caused by pipeline construction across the Colorado River should therefore create few (if any) unfavorable impacts on those species unless construction occurred during spawning periods when an increase in stream sediment might destroy fish eggs by covering them with silt. The applicant has proposed to construct across the river during low flow periods. Lowest flow is in December and January; therefore, if construction were conducted during this period, spawning impacts would not occur. Lower Colorado River fisheries may already be experiencing some environmental stress as a result of increased salinity caused by irrigation practices (Pratt, 1972).

Impacts of construction on ecologically sensitive areas on the Colorado River, such as the backwater lakes just below the proposed crossing and the Imperial and Cibola National Wildlife Refuges (Figure 2.1.8.2-4), would depend upon amounts of turbidity and sedimentation produced by construction at the proposed pipeline crossing site. Turbidities of the backwater lakes approximate those of the river. Backwater lakes, connected to the river by culverts, could receive suspended sediments from the river; however, these lakes are shallow and mix completely from top to bottom, so that part of their turbidities may be produced within the lakes themselves.

Impacts of construction on the two national wildlife refuges would be determined by the distance downstream that turbidity and sediments are transported. Since existing ecosystems in this section of the Colorado River developed after the construction of Lake Mead clarified the river, they may be sensitive to high turbidity and deposition of new sediments. The life form most likely to be affected would be the submerged macrophytes which depend upon the transmission of light through water for photosynthesis. The refuges, however, are approximately 17 and 33 miles downstream from the proposed river crossing. As the heavier sediments would settle out before reaching the refuges, the farther downstream they are from the construction site, the less the impact would be.

Other aquatic systems to be crossed by the proposed pipeline support limited sport fisheries. However, increased demand for water resulting from urbanization and industrial and agricultural expansion probably limits the success of sport fisheries in heavily populated areas by decreasing available water and lowering overall water quality. Hence, pipeline construction across coastal streams such as the Los Angeles River, which has a greatly altered physical structure, would probably create little impact.

Several small riparian sites in the California Coastal Biome could be impacted in the area where new construction would take place. The San Gabriel River channel, downstream from the Whittier Narrows Dam crossing, and part of the San Jose Creek channel provide riparian habitat for a variety of reptiles and amphibians as well as other forms of wildlife (Figure 2.1.8.2-1). These riparian areas could be affected by new construction activities if care is not taken to avoid them.

Construction impact on birdlife can be variable, depending on time of construction. Winter construction in areas inhabited by waterfowl and marsh birds (e.g., San Gabriel River or Whittier Narrows Basin) would probably force birds to shift temporarily to less favorable areas or areas already containing capacity populations. Construction during the nesting season may cause nest desertion by some birds in adjacent areas not directly affected by construction (e.g., Whittier Narrows Basin). Waterfowl, shorebird, and marsh bird habitats altered by construction (e.g., Colorado River crossing) should remain minimally utilizable by such birds until marginal vegetation becomes reestablished. Construction near wash woodlands may directly eliminate bird habitat or indirectly eliminate habitat by diverting the seasonal water flow necessary to sustain existing plant life into another drainage.

The Chuckwalla Valley dune-thicket is in the Colorado Desert, just east of Ford Dry Lake. This thicket has extremely dense vegetation which harbors a variety of wildlife (Figure 2.1.8.2-1). An unique habitat type, the thicket has higher wildlife densities than those of any other area along the proposed route in the Colorado Desert Biome. Some representative species identified there include the desert iguana, Mojave fringe-toed lizard, western whiptail, glossy snake, gopher snake, Gambel's quail, white-winged dove, ladder-backed woodpecker, phainopepla, Audubon cottontail, coyote, and kit fox. This relatively undisturbed area is currently being inventoried by the Bureau of Land Management, Riverside (California) District. The pipeline route as proposed would pass within approximately .75-mile of this area. Construction activities would impact the isolated, disparate ecosystem by physical construction disturbance or by increasing public accessibility if the right-of-way were to pass through or near the thicket.

The agricultural water conveyance systems within the Palo Verde Valley also provide important riparian habitat. New construction in that area may destroy some of the habitat either by diverting or polluting existing water systems. New construction east of the Colorado River does not cross or go near any aquatic or riparian habitat other than the Pecos River which was previously discussed.

3.1.8.2.2 Operation

Operation and maintenance of the proposed pipeline would either perpetuate or modify local environmental alterations created by previous construction activities. Like construction impacts, the magnitude of operation and maintenance impacts would be a function of the type of habitat affected.

Terrestrial

Routine pipeline operation and maintenance would continue to create long-term impacts resulting from maintenance of access roads and pump station operations for at least the projected 25-year life of the project along the existing pipeline. In areas of new construction, new long-term impacts would occur. After the project is abandoned, the access roads would continue to be used for recreational purposes. Maintained rights-of-way and access roads would be prevented from undergoing natural ecological succession and, as such, would remain biologically desolate. Once the topsoil is disturbed, it might be 50 years or even longer before reestablishment of native vegetation would occur, especially in the desert biomes. The recovery period would be prolonged on access roads. Rights-of-way and road maintenance would cause increased erosion in deserts because of lack of plant cover on roads and within the right-of-way. Impacts associated with roads and pipeline maintenance would also result from dust deposition on vegetation in about a 15-foot-wide swath along both sides of the access road rendering the affected plants less palatable to herbivores.

Increased soil erosion, simplified vegetative structure and altered drainage patterns would produce variable effects on faunal communities. In any community where food and cover was reduced or eliminated, the fauna would be eliminated or reduced in density and/or variety. However, animals might be expected to reside in areas adjacent to maintained roads, pump stations, and rights-of-way, if sufficient food and cover existed there to meet their daily requirements. Vertebrates, such as deer and desert bighorn sheep, which are particularly wary of human activity, would be likely to continue to avoid heavily used rights-of-way and access roads in favor of more isolated environs.

A secondary long-term impact of pipeline operation and associated maintenance of access roads is that off-road vehicles (ORVs) would have continued access to areas adjacent to the existing pipeline route and additional access to areas adjacent to the new pipeline route. Frequent or intensive ORV operation characteristically damages and/or eliminates vegetation in the areas used. Damage to vegetation and formation of ORV trails would accelerate erosion, compact soils (impeding water penetration), and alter natural drainage patterns. These changes, which affect vegetative patterns, secondarily produce changes in resident wildlife populations by altering the availability of food and cover. Reduction in the resources necessary to sustain wildlife populations, coupled with increased human activity and associated noise would have an adverse cumulative effect upon resident wildlife.

The proposed Black Mountain Pump Station site in the Arizona Upland Desert Biome is noted for its outstanding dove and quail concentrations. The pump station, with its noise and increased human activity, would cause a decrease in the number of birds utilizing the immediate area within a one-fourth mile radius from the pump station. Section 3.1.11.2.2 discusses the noise levels that could be expected at the pump stations.

Although the possibility of a major oil spill is remote, the most serious potential impacts on wildlife are those that would result from an accidental oil release. The reader is referred to Section 3.1.5.2.2 for a discussion of oil spill probabilities and impact magnitudes. Terrestrial effects of an accidential oil release are, at best, difficult to predict. The magnitude of impact in any area would depend on several factors, including: (1) volume of release; (2) the biological significance of the area; (3) time of release; (4) soil characteristics in the area of the release; (5) nature of affected detritus; (6) topography in the affected area; and (7) flow stage in surface drainage and rate of spread.

An ecologically sensitive area in the California Coastal Biome that would be adversely impacted by an oil spill is the San Timoteo Canyon. The coastal sage scrub habitat type in this canyon is the habitat type preferred by the Stephens kangaroo rat which is classified as rare by the state of California. This species has recently been reported as occurring in the canyon (Figure 2.1.8.2-1).

In the Colorado Desert Biome, sand dune habitat types in Coachella Valley and the Ford Dry Lake area would be impacted by an oil spill, although the extent of the impact would probably be limited in size because of the absorptive character of this habitat type. Reptiles would be the species most affected in those types (Figure 2.1.8.2-1).

In the Yuman Desert Biome, the existing pipeline route passes through the Dome Rock Mountains, one of the best bighorn sheep habitats in the state. In fact, the corridor bisects one of the most important sites for bighorn sheep in the entire Dome Rock Mountain system (Figure 2.1.8.2-2). An oil spill in that area would almost certainly adversely affect bighorn habitat. Emergency crews sent in to repair the pipeline also could impact the sheep, depending on the time of year. Lambing takes place on the cliffs above the pipeline, and seasonal migrations cross the pipeline corridor there. Also, one of the few sources of permanent water in this area lies next to the existing pipeline. A spill there could adversely affect the local population by removing from 1 to 20 acres of critical habitat from the already limited bighorn sheep range.

Mule deer and peccary can be found along much of the pipeline route in the southern part of Arizona and New Mexico. In the Arizona Upland Desert Biome, any impacts on those wide ranging and mobile animals would be slight; No critical deer or peccary habitat sites where an oil spill would have a major impact have been identified along the existing route. The same is true of the mule deer and peccary range in the Desert Grassland Biome in the southeast corner of Arizona (Figure 2.1.2.2-1).

Aquatic

The primary impacts of operation activities would revolve around the possibility of an accidental oil release into aquatic habitats. The extent and severity of the impact of an accidental oil release upon an aquatic environment depends upon a multitude of factors, including (1) volume of release; (2) location; (3) topography and general environment; (4) time of year of release; (5) stream velocity and volume; (6) amount of suspended material in the system; and (7) effectiveness of emergency procedures.

Although the biological consequences of a particular release cannot be accurately assessed until the above-mentioned factors are known, a few general comments concerning the nature of possible impacts can be made. Refer to Section 3.1.5.2.2 for a discussion on the potential volumes of oil that could spill in the rivers traversed by the proposed project.

Petroleum products are damaging to aquatic biota in four principal ways (FWPCA, 1968): (1) by coming into direct contact with the organism; (2) by forming emulsions which may smear gills or be swallowed with water and food; (3) by forming a heavy film on the water surface which may interfere with gas exchange and respiration; and (4) by poisoning organisms with various water-soluble substances which may be leached from petroleum products.

One of the most noticeable and dramatic impacts of waterborne oil releases is their effect on waterfowl, inasmuch as the natural buoyancy and insulation of the waterfowl's feathers are destroyed when coated with oil. Even the less visible components of aquatic ecosystems are damaged. Phytoplankton and zooplankton, primary sources of food for fish, may be either destroyed or coated with oily substances. If coated plankton is ingested by fish, an oily smell and taste may be imparted to the flesh. Fish also may be impaired or killed when the epithelial surfaces of their gills become coated with a film, thereby inhibiting respiration. Settleable oils also may coat stream bottoms, destroying benthic organisms and interfering with spawning and reproduction. Reproductive capacity of benthic organisms may even be impaired in some cases (Murphy, 1971).

The Colorado River would suffer greater adverse environmental impacts from an accidental oil spill than any other area along the pipeline route. The impact of oil on microscopic plants, should a spill occur in the river, would depend first on the quantity of the spill and the time required for cleanup. The difficulty in evaluating the effects of oil on the aquatic ecosystem arises from the fact that oil is not a single substance, but a complex mixture of varying quantities of chemical compounds (Murphy, 1971). Because of this variability in chemical properties, oils may vary in toxicity, solubility, biodegradability, density, volatility, and carcinogenicity. Although comparatively little information is available on effects of oil on freshwater ecosystems, the information available indicates that oil may be detrimental in several ways. For example, oil can be directly toxic (via naphthenic acid, phenol, etc.) to aquatic organisms (Cairns et al., 1972), can form surface films on the water that interfere with gaseous exchange between the air and water interface, and can coat substrata and sediment surfaces and render them unsatisfactory for colonization (Hoehn et al. 1974).

Adverse effects occur relatively soon after an oil spill in freshwater streams and river systems with only limited opportunity to recover oil at sites in close proximity to the spill (Bury, 1972; McCauley, 1966; Meynell, 1973; Nauman and Kernodle, 1975). It has been reported by Hoehn et al. (1974) that the general tendency immediately following an oil spill is a reduction in number of benthic invertebrates but only limited reduction in overall diversity in community structure. This suggests the universal toxicity of certain water-soluble aromatic oils.

Oils incorporated into bottom sediments generally produce anaerobic or oxygen-deficient conditions by reducing gas exchange between the sediment-water interface (Murphy, 1971). Once oxygen levels are reduced to negligible levels in the sediment, degradation of oil is relatively slow. This may lead to oil traces in the river for 3 to 10 years, depending on the magnitude of the spill, sediment particle size, nutrients, light, temperature, and exposure to current (Moore and Dwyer, 1974).

Oil introduced into the aquatic environment is initially toxic to many primary producers. Further damage results from oil entering plant tissue where it affects cell membrane permeability and interferes with cellular respiration and photosyntheses. Oil has similar effects on consumers by interfering with gas exchange, restricting filter-feeding, and changing existing benthic habitats. Ultimately, changes occurring at lower trophic levels result in modification or reduction of members at or near the top of the food web (e.g., fish, waterfowl, and carnivores). Modification or reduction of aquatic macrophyte communities would ultimately reduce the available habitats for waterfowl and other animals that rely on shoreline macrophyte communities for feeding and reproduction.

The impact of an oil spill from the proposed pipeline in the Colorado River would be slight to catastrophic to the aquatic ecosystem, depending on the volume of the spill. At the least, one could expect elimination of many or most of the periphytic and benthic microscopic plants in the downstream vicinity of the spill. Oil remaining on the shoreline and on bottom sediments would also prevent or retard recolonization (Cairns et al., 1972). This situation could result in a downstream area where conditions would require time for benthic aquatic plant life to become reestablished.

Each of the major rivers is bounded by one remotely controlled block valve on the "upstream" side of the oil flow and a check valve on the "downstream" bank, except the Pecos River which is bounded by two remotely controlled block valves. Assuming a major break were to occur at one of the river crossings, the pipeline dispatcher upon detecting the pressure drop would immediately shut down the "upstream" pump stations (approximately 1 minute.) The "downstream" pump stations would continue to operate, evacuating much of the oil remaining in the pipe, the amount of oil evacuated depending on the pressure head at any given break location. Once the upstream pump stations began shutting down with a subsequent drop in pressure, the main-line valves would close, restricting the flow of oil from reaching the break. Closure time would be approximately 10 minutes.

The time required to clean up an oil spill and the efficiency of the clean-up operation is dependent on the location of the spill. If the pipe were to break at the Colorado River crossing, for example, clean-up crews would attempt to keep the spill in the main river channel until it reached Imperial Dam where it would be contained and cleaned up.

The probability of a pipeline break anywhere along the line, based on the number of breaks that have occurred in the past on all pipelines in the United States, regardless of the age of the pipe, is .00116 spill accidents per mile of pipeline. This pipeline throughout, especially at the river crossings, would be newer than the national average. By assuming that the total amount of oil between the valves would be spilled (.6 mile at 71.97 gal/ft (or 1.71 bbl/ft) in a 42-inch pipeline), including the amount of oil lost during remote block valve closure time (about 50 to 60 barrels at

500,000 bbl/d throughput), the maximum potential spill volume in the Colorado River is estimated at 5,417 barrels (Table 3.1.5.2.2-2).

In the event of an oil spill in the lower Colorado River, the ecologically sensitive areas downstream would be severely impacted. The backwater Lakes A-7 and A-10 (Figure 2.1.8.2-4) are within 2 miles of the pipeline crossing, and oil would probably reach the lakes within the first two hours of oil leakage, assuming current velocities of 1 mph or greater. Since both lakes freely exchange water with the river through culverts in the levee, the probability of oil contamination is high (Table 3.1.8.2.2-1).

Table 3.1.8.2.2-1

Estimates of Time in Hours Required[a] for Oil Moving at Different Velocities to Reach Segments of the Lower Colorado River Below the Proposed Pipeline Crossing

MILES DOWN-STREAM	Location	Hours at Surface Velocity (miles per hour) 1	2	3	4	5
0	Proposed pipeline crossing site					
2	Lake A-10	2	1	1	1	1
3.7	Peter McIntyre County Park	3	2	1	1	1
5		5	2	2	1	1
10	38th Street County Park	10	5	3	2	2
15		15	8	5	4	3
20	Cibola National Wildlife Refuge	20	10	7	5	4
25	Cibola National Wildlife Refuge	25	12	8	6	5
30	Cibola National Wildlife Refuge	30	15	10	8	6
35	Imperial National Wildlife Refuge	35	18	12	9	7
40	Imperial National Wildlife Refuge	40	20	13	10	8
45	Imperial National Wildlife Refuge	45	22	15	11	9
50	Imperial National Wildlife Refuge	50	25	17	12	10
55	Imperial National Wildlife Refuge	55	28	18	14	11
60	Picacho State Recreational Area	60	30	20	15	12
65	Imperial National Wildlife Refuge	65	32	22	16	13
70	Imperial Dam	70	35	23	18	14

Source: Blinn et al., 1976.

[a] Estimates are to the nearest hour.

Normal operation and maintenance of the proposed pipeline crossing would have negligible effect on the ecologically sensitive areas of the lower Colorado River. Shortly after construction, the bed of the river would reach erosional equilibrium with the discharge of the river. This discharge is controlled by the operation of Palo Verde Diversion Dam. Since the pipeline is to be placed below the depth of scour, its presence would not influence the hydrological characteristics of the river.

The Cibola National Wildlife Refuge is about 17 miles downstream from the proposed pipeline crossing. With surface current speeds ranging from 1 to 5 mph, an oil spill would reach the refuge in 3 to 17 hours. The stream bed in the refuge is channelized, and backwaters such as Cibola Lake are isolated from the river. Direct contamination of the area by oil would be confined to the river channel. However, backwaters would be subject to diffusion of oil and water-soluble oil fractions through sediments of the floodplain.

The Imperial National Wildlife Refuge begins 33 miles below the proposed pipeline crossing (Figure 2.1.8.2-4). With current speeds ranging from 1 to 5 miles per hour, an oil spill would reach the northern boundary of the refuge in 7 to 33 hours. The main river channel in Imperial Reservoir is not lined with levees, and the most of the lakes are connected to the main channel either by unobstructed waterways or through the marsh vegetation. Direct contamination of the reservoir by oil would reach the backwaters and marshes in addition to the main channel.

Along the 37 miles of river channel from the beginning of the Imperial National Wildlife Refuge to Imperial Dam, access to the river is possible at less than 10 locations. Access to the river is limited by thick riparian vegetation and marshes which border the river. Open waterways are accessible by boat from Fisher's Landing and Martinez Lake, Arizona, and Imperial Dam and Picacho State Park, California. Once distributed into the marshes and backwaters of Imperial Reservoir, oil would be difficult to remove because of inaccessibility to the river. Thus, accumulations of oil remaining in the area would produce maximum adverse effects on the biological community lasting from 3 to 10 years.

Other rivers along the proposed pipeline route, which have at least some year-round water flow or have large enough bodies of standing water to support some fish life, are the San Pedro and Gila rivers in Arizona and the Rio Grande and Pecos River in New Mexico. Table A2.1.8.2-5 in the appendices lists the fish species one would expect to find in those rivers. The adverse impacts on those rivers from an accidental oil spill would be similar to those on the Colorado River, but on a much smaller scale because of the smaller volumes of water transported in those rivers.

The Palo Verde Valley agricultural water conveyance system bordering the west bank of the Colorado River freely exchanges water with the river and would be severely impacted by an oil spill. Since a variety of fish and other wildlife move back and forth between the river and the irrigation system, an oil spill there would not only impact the wildlife in the irrigation system but would also find its way into the river. Conversely, any spill in the river would impact the agricultural irrigation waters rendering those waters unfit for wildlife for an indeterminate period, depending on the spill magnitude.

There are several other sensitive riparian sites along the proposed route where dependent wildlife would be affected in case of an oil spill. Portions of the San Gabriel River and San Jose Creek channels, and the San Timoteo Wash in the California Coastal Biome, have some riparian habitat on which a wide variety of wildlife species depend (Figure 2.1.8.2-1).

The pipeline crosses the Gila River (Figure 2.1.8.2-2) about 1,000 feet downstream from Gillespie Dam, a diversion structure for irrigation. Not all water is diverted, and the amount that continues downstream is variable. For example, in 1974 it ranged from 2.9 to 57 cubic feet per second (USGS, 1974). This flow gradually disappears into the alluvium of the Gila River. Occasionally, large floods pass over Gillespie Dam and continue downstream to Painted Rock Reservoir. Some flow below Gillespie Dam is present throughout the year with velocities mostly less than 1.5 feet per second (1 mph).

The maximum amount of oil that could spill at the Gila River crossing as a result of rupture would be about 139 bbls. During low flow this oil would be absorbed into the Gila River alluvium within a mile or two downstream. The distance from Gillespie Dam to Painted Rock Dam is about 40 miles, and oil if unchecked could reach Painted Rock Dam in about nine hours when the river is in flood stage.

This stretch of the Gila River from the crossing to Painted Rock Reservoir provides some of the most outstanding wildlife habitat in the Yuman Desert Biome. Dove and quail populations are extremely high there as well as a variety of songbirds. As water and the attendant riparian habitat is the limiting factor for most wildlife populations in the deserts of the Southwest, oil degredation of this habitat will undoubtedly cause reductions in local populations of white-winged dove, mourning dove, Gambel's quail, red shiner, mosquito fish, green sunfish, and bluegill.

The maximum potential spill volume at the San Pedro River crossing is 4,260 barrels (Table 3.1.5.2.2-2). The depth to the water table in the San Pedro River floodplain is fairly shallow, ranging from 6 to 40 feet, so an oil spill would quite likely contaminate the water table. If this occurred, the groundwater that surfaces in the form of springs and seeps would be unavailable to wildlife for at least 3 to 10 years.

A major oil spill during low flow would behave in a manner similar to that for the Gila River. During floods, mean velocities of 6.8 to 8.2 miles per hour occur. Therefore, an oil front would advance 17.5 miles in the time it would take for clean-up crews to arrive at the site. The effects of a major oil spill during flood stage also would be similar to those on the Gila River. However, because the water table is shallower, there would be more opportunity for the oil to contaminate it. Some typical wildlife species that would be affected by an oil spill include the speckled dace, longfin dace, gila sucker, bluegill, mosquito fish, dove, quail, various songbirds, and deer.

The duration of impact on the aquatic wildlife habitat along the Gila and San Pedro rivers would vary depending on the magnitude and time of spill, and the efficiency of the cleanup operation. Since all the oil would not be recoverable, some areas would show signs of oil pollution for as long as 3 to 10 years after the accident.

An oil spill in the Florence Casa Grande irrigation canal which is crossed near Coolidge, Arizona, would adversely impact Picacho Reservoir which lies several miles to the south of the proposed crossing (Figure 2.1.8.2-2). Using a reaction time of 1 hour from Casa Grande to turn off the valve and a distance of 1.3 miles between the "downstream" check valve and the "upstream" manual valve, the calculated maximum amount of oil that could spill into the canal due to a pipeline rupture is approximately 26,900 barrels. Picacho Reservoir is a large marsh that provides habitat for ducks, shore birds, and extremely high numbers of doves. The reservoir and irrigation canal are also fished quite heavily for warm-water fishes. An oil spill would reduce the productivity of this habitat for at least three years, and would kill many animals that came into direct contact with the oil.

Willcox Playa, in Sulphur Springs Valley, Arizona (Figure 2.1.8.2-2), is an intermittent lake located about 10 miles south of the pipeline route. The playa is used by migrating waterfowl, including the Endangered Mexican duck, as a resting area; some nesting occurs along the west side in the irrigation tailwaters adjacent to barley and wheat fields. The sandy areas in the vicinity offer excellent reptilian habitat. Dove and quail populations are also very high there. The San Simon drainage lying just to the east of Willcox Playa provides similar wildlife habitat. A major oil spill in those areas could potentially cause major degradation, depending on the absorptive nature of the soils between the pipeline and the playa. The mobility of the oil would be dependent on the permeability of the subsoil. Should the oil encounter an impermeable clay layer several feet below the sandy surface, lateral movement would probably occur. Should oil get into either Severin Wash or Long Canyon Wash during or immediately after a large rainfall, oil would quite likely reach the playa as both of these washes drain onto the playa flats. The maximum amount of oil that could be spilled in Sulphur Springs Valley and San Simon Valley would be about 90,000 barrels and 55,800 barrels, respectively.

In the Chihuahuan Desert Biome, the proposed pipeline route crosses two other major rivers, the Rio Grande and Pecos (Figures 2.1.8.2-3). At the point where the pipeline crosses, the Rio Grande has very little water flow because of the irrigation diversions upstream. Nevertheless, many forms of wildlife, such as bluegill, channel catfish, green sunfish, mourning dove, crissal thrasher, hooded skunk, deer, and collared peccary, utilize the river and would suffer if it were degraded by an oil spill.

The distribution of oil from a major spill due to rupture of the pipeline at the Rio Grande would be governed by the amount of water flow at the time. Below the existing crossing the river is entirely channelized to American Dam at El Paso, a distance of 25 miles. The estimated time to reach the dam ranges from six to nine hours. American Dam is only a diversion structure so any oil that would reach that far would not be contained, but continue down the river.

The estimated maximum potential spill volume into the Rio Grande is estimated at 1,805 barrels. The estimated clean-up response time is 2.5 hours from Deming, New Mexico. During this time the oil would travel about 7 to 10 miles. (Note: All reaction times and spill volumes were supplied by Williams Brothers Engineering Co., Tulsa, Oklahoma, by correspondence dated 30 July 1976).

The Pecos River maintains a fairly steady flow for most of the year, ranging from about .3 to 3 miles per hour. The estimated potential spill volume at the Pecos River crossing is 8,103 barrels. In the two hours that it would take to get clean-up crews to the rupture site from Jal, New Mexico, the oil would travel an estimated 2 to 8 miles, depending on the river discharge.

Red Bluff Reservoir, comprising about 11,700 surface acres (pers. comm., Bureau of Reclamation, 1976), lies about 3 miles south of the pipeline crossing in the state of Texas. If the pipeline were to rupture at the Pecos River crossing, oil would almost certainly reach the reservoir before it could be contained. Because of the irregular shoreline, clean-up operations in the reservoir would be extremely difficult.

Below the existing pipeline crossing, the Pecos River and Red Bluff Reservoir are major fishery and recreation areas. If an oil spill were to enter those waters, the adverse impacts to that aquatic habitat would be second only to those for the Colorado River. Some of the sport fish that would be affected include white bass, largemouth bass, bluegill, channel catfish, and green sunfish. A wide variety of shorebirds, waterfowl, songbirds, and terrestrial wildlife also utilize those waters and would suffer temporary local population reductions. Depending on the severity of the spill and success of clean-up operations, a spill could eliminate some species in those waters.

3.1.8.3 Rare, Threatened, Endangered, or otherwise protected species

3.1.8.3.1 Conversion/construction

Ocean

No impacts have been identified with the conversion/construction phase.

Port of Long Beach

Project impacts on the least tern and brown pelican, both on the Federal Endangered list, would be minimal. Construction of the proposed project would not affect the least tern, whose major area of occurrence is Los Angeles Harbor around the seaplane basin breakwater (Stations 71, 72, and 73, Figure 2.1.8.1.3-1.) The brown pelican might be displaced from some open water feeding area, but breakwater construction would provide an additional resting area for this species. No Threatened or Endangered nonavian land species would be affected by the proposed action.

Pipeline route

Potentially, the greatest pipeline construction impact would be upon those wildlife species which are endemic, of limited distribution, or have a special protected status such as Rare, Threatened, and/or Endangered. Many of these specifically protected vertebrate species, listed in Table A2.1.8.3-1, have limited distributions which are exclusive of the proposed pipeline right-of-way. Because of low population densities, limited distributions, and specialized habitat preferences, the likelihood of encountering most of the specially protected vertebrates during construction is small, hence impact should likewise be minimal.

Although construction activities would prevent utilization of certain areas by wildlife, the total amount of habitat removed from production is quite small. There should be no long-range threat to any of the more mobile species, such as birds or large mammals, along the proposed pipeline route. There is a slight possibility of impacting certain Endangered species which are restricted to specific breeding sites or unique habitat. For example the Gila woodpecker, which is considered Endangered by the state of New Mexico, generally breeds only in saguaro forests. Saguaros are rare in New Mexico, occurring only in the southwestern portion of the state. Destruction of saguaro cacti in New Mexico could cause a decrease in the breeding population of the Gila woodpecker. Fortunately, there are no large saguaro stands within the proposed corridor, although small stands or isolated plants may be encountered by access roads, borrow pits, power-line corridors, etc.

Also, adverse impacts could occur to some of the less mobile protected species such as the desert tortoise in California and Arizona, or the Arizona coral snake in New Mexico. Likewise, habitat of the Yuma Clapper rail, classified as Endangered by the Federal government, and the spike dace, considered Threatened in Arizona could potentially be impacted during construction across the Colorado River.

Stephens kangaroo rat, classfied as Rare by the state of California, has been reported in the coastal sage shrub habitat type in San Timoteo Canyon. The proposed pipeline route appears to narrowly miss this vegetative type, but if any alignment changes become necessary this specifically protected animal could lose several acres of already limited habitat.

Construction of proposed pump stations would alter a maximum of approximately 10 acres of land at each pump station site. This acreage would essentially be lost as wildlife habitat. Animals would be displaced from these sites, but the small size of each site, along with the fact that no known Threatened or Endangered species habitat occurs at the proposed location, reduces the possibility of adverse impacts. As a long-term effect, some species may simply avoid the immediate vicinity of pump stations as a result of increased activity in the area.

The following discussion identifies those species listed in Table A2.1.8.3-1 that have the greatest likelihood of being adversely impacted by the operation of the proposed project.

3.1.8.3.2 Operation

Ocean

All eight of the Federally Endangered species of whales (fin, humpback, sei, sperm, blue, gray, right, and bowhead), as well as the Federally Endangered American peregrine falcon, short-tailed albatross, Aleutian Canada goose, light-footed clapper rail, California least tern, California brown pelican, and Belding's Savannah sparrow, could potentially be affected by oil pollution along the tanker route and in the ports of Valdez and Long Beach. Oil spills during the nesting season could adversely affect reproductive success as well as feeding habitats. Potentially affected species considered Rare by California include the California black rail, the Guadalupe fur seal, and the island fox.

Of the marine mammal species discussed in Section 2.1.8.1, the majority of species under this heading are cetaceans. As previously mentioned, there have been no extensive experimental studies conducted on the effects of various petroleum products on most of these species. A listing of Endangered, Rare, and Threatened birds and marine mammals is given in Appendices A2.1.8.3-2 and A2.1.8.3-3.

As discussed in Section 3.1.8.1.2, the California sea otter is the most vulnerable of all the marine mammals in the project area. The sea otter was added to the Federal Threatened list in January, 1977. An oil spill reaching a sea otter population would significantly reduce, if not eliminate it. Unlike the cetaceans and pinnipeds (other than the fur seals), oil would be fatal to the sea otter even if it coated only a small portion of the animal's body. The risk of secondary impacts (contaminated or reduced food supplies, for example) is much less, but is still a potentially serious impact.

The only Endangered species that received detailed study during the Santa Barbara oil blowout was the California gray whale, Eschrictius gibbosus, which was apparently unaffected although the whales were in their annual northern migration during the incident. According to the California Department of Fish and Game (1969), there was some concern about the California gray whales that were passing through the area on their northern migration. On 3 February 1969, a young gray whale was observed from the air floating near the surface in an area with considerable oil and straw on the water. At first glance, the whale appeared dead; however, when the plane made a second pass to get pictures, the animal dived and swam away. Other whales were observed in the oil leak area during the first half of February, but none showed any signs of being in distress. There were five whales (three were California gray whales) that did wash ashore in February and March at various points along the California coast. On 14 March 1969, the department conducted an aerial survey of the coast from Ventura to Monterey but failed to find any more dead whales floating at sea or washed up on the beach. An autopsy performed on one of the whales that washed ashore failed to determine cause of death, but there was no sign of oil in any of the whale's vital organs. Historically, two or three dead California gray whales wash ashore each year along the California coast during the late winter and early spring months. During some years there have been as many as five.

While whales occur along the tanker route at various seasons of the year, it is probable that from southern California to the Gulf of Alaska whales are present the majority of the time. Since they move continuously, and over a relatively extended period of time, the probability of their exposure to a single spill is considered small. This is based on the data presented in Section 3.1.5.1.2; i.e., the probability of an oil spill, the physical and chemical fate of the oil, the possible oil spill trajectories along the route, and the impacts on the water quality. Whales are submerged most of the time, which would minimize their exposure to floating oil. In addition, their absence of hair restricts oil adherence to their skin, thus reducing the opportunity for prolonged body contact with oil.

A potential danger to cetaceans is absorption or adsorption of oil through or on the mucous membrane lining the blow hole distal to the nasal plug. The ultimate outcome of oil exposure could be a thin oil film covering the lungs and respiratory passages. This could lead to death of the animal. Although the effect of this impact cannot be quantified, it is not considered to be significant enough to reduce whale populations along the tanker route, based on the spill analysis in Section 3.1.5.1.2.

Whale populations could be temporarily displaced from areas where a large oil spill would locally reduce their food organisms. Since cetaceans are very mobile and forage over large areas, localized oil spills and their concomitant local reductions in food supply are not anticipated to adversely affect permanent or migratory whale populations along the tanker route.

Bays, estuaries, and ports

Birds that occupy the bays and ports are in the greatest danger from an oil spill. The most critical waters in this class are those of Port Valdez, Prince William Sound, the Copper River, and Blything Sound, in Alaska; and off the west coast from Point Conception to Long Beach, including the Channel Islands in California. Birds involved include the Aleutian Canada goose, the California brown pelican, the light-footed clapper rail, the California clapper rail, the California least tern, and Belding's Savannah sparrow.

If large quantities of oil from a spill were to invade a wetland habitat occupied by any of these birds, death to the individuals could result from loss of insulative value because of oil soaked feathers, ingestion of oil covered food, or loss of nesting sites. Since these species are rare in the first place, the complete elimination of them in a given oiled bay is possible. The possibility of repopulating a destroyed area from another bay would depend upon the number of bays severely oiled and the number of additional bays occupied by a given species. For example, the increased numbers, migration habit, and wide distribution of the least tern should provide a sufficient population stock to enable them to reinhabit affected areas after an oil spill has been cleared. The principal breeding season is the spring of the year, so reoccupation would not begin until the following spring or even a year or two later. Reproduction would probably begin the year following reoccupation.

The more scattered distribution of the California clapper rail and possibly Belding's Savannah sparrow might prevent those species from natural reoccupancy. They are not migrators and spend their lives in a restricted area. The Belding's savannah sparrow occurs as a resident in the tidal estuaries of southern California and Baja California, Mexico. It is closely associated with pickleweed habitat which is subject to tidal influences. The California clapper rail is a resident in salt marshes of San Francisco Bay, San Pablo Bay, Kopa Marsh, and Elkhorn Slough and is a casual visitor to Bolinas, Tomales, and Humboldt bays. Therefore, a major oil spill reaching their habitat could cause significant reductions on those already limited populations. From the data presented in Section 3.1.5.1.2, the probability of an oil spill reaching the shores of the San Francisco Bay area where the clapper rail is found is quite small because the tanker route is at least 50 miles offshore. However, some of the Belding's savannah sparrow habitat from Goleta Slough, Santa Barbara County, to San Diego Bay would be impacted as current and wind studes in the Santa Barbara Channel strongly suggest that oil spills in that region would affect the mainland coast (note Figures 3.1.5.1.2-6 through -9).

The brown pelican nests only on Anacapa Island about 6 miles off the east end of Santa Cruz Island (Section 2.1.8.4) and feeds on ocean fish. There is a possiblity that hydrocarbons may build up in the food chain and accumulate in tissues, in a manner similar to DDT. The effect of chronic hydrocarbon buildup in tissues of pelicans is not known.

Although 12 to 20 pairs of peregrine falcons inhabit the north Gulf of Alaska coast area, they are probably not the Endangered American peregrine falcon. These birds are most likely Peale's peregrine falcon. Peregrines, in any case, would not be likely to be affected by oil pollution as they probably would not be attracted to oil-contaminated beaches in search of prey after an oil spill incident (e.g., dead or dying fish, birds, and other wildlife) since they are not scavengers. However, a large spill has the potential to adversely affect large numbers of waterbirds (which peregrines, in part, feed upon) and thereby peregrines would be adversely affected. Most likely, peregrines would forage greater distances, or would turn to more readily available and suitable prey items.

Short-tailed albatrosses occur in pelagic areas of the northern Gulf of Alaska where their foraging and roosting behavior would make them vulnerable to becoming oiled in an offshore oil slick. Their numbers range from about 75 to 100 birds. Because of their low numbers and the vast area encompassed by their winter range, the opportunity for a short-tailed albatross to come into contact with an oil slick is very remote however, a loss of a few short-tailed albatrosses would be considered very significant.

The Endangered Aleutian Canada goose formerly bred on some of the Kuril Islands, Bering Island (Commander Islands), and many of the Aleutian Islands (as far east as the islands of the Four Mountains). They now breed only on Buldir Island where the estimated population is about 800 geese. Although there are no sight records for the Endangered Aleutian Canada goose from Cold Bay, Alaska, to central California (Castle Rock Island) where they appear to winter, it is possible the geese cross the Gulf of Alaska in late

April and again in August. They arrive at Buldir Island in the middle of May and probably leave in late August. Their migration route may be transoceanic in fall and coastal in spring; however, both fall and spring migrations could be either transoceanic or coastal. If the route is coastal, there are still no data to suggest the geese stop over along the northern Gulf of Alaska coast. Theoretically, if they do stop over in spring and fall (e.g., in the Copper River delta or any of the coastal bays), they could be vulnerable to becoming oiled in case of a spill coming ashore in the above areas. With so many unknown variables, no attempt has been made to quantify the significance of this impact.

It is unlikely that operation and maintenance of the proposed project will significantly impact the Federally Endangered brown pelican or least tern. Neither species frequents the proposed project area in Long Beach Harbor to any great extent, although an oil spill could potentially restrict the brown pelicans' use of open water areas for feeding.

Pipeline route

Within the California Coastal Biome, several species having a protected status could be impacted if a major oil spill occurred. There are also several species presently being considered for inclusion on the Federal Threatened or Endangered list such as the two-striped garter snake and San Diego horned lizard, both of which are found in this biome.

The white-tailed kite, which is fully protected in California, and the southern bald eagle and American peregrine falcon, both of which are on the Federal Endangered list, could potentially be encountered along the pipeline right-of-way, although the chance of impacting these raptors by pipeline operation is actually very slight. Collisions with transmission lines, especially by young raptors, would be one such impact, although all new power lines would be designed to minimize raptor electrocution.

The Colorado Desert Biome has several sensitive areas, including the Colorado River, where Federal or state protected wildlife could be adversely impacted. For example, the Coachella Valley fringe-toed lizard, occurs in sand deposits in and near the Coachella Valley between San Gorgonio Pass and Indio (Figure 2.1.8.2-1). This species occurs only in about a 120-square-mile area and is currently being considered by California for inclusion on the state Rare or Endangered list (Stacey, 1976: pers. comm. Calif. Fish and Game). Also, habitat of the desert tortoise, which has a "special protection" designation in California and considered Threatened in Arizona, would be encountered along much of the proposed route through the deserts of southern California and Arizona where an oil spill would effectively remove several acres of habitat.

Three protected fishes which might be impacted by either pipeline construction or accidental oil spill on the Colorado River are the Colorado squawfish, considered Endangered by the Federal government and California; and the humpback sucker and bonytail chub, classified as Rare by California. The bonytail chub and Colorado squawfish are believed to presently occur in the Colorado River above the proposed pipeline crossing and probably would not be impacted. According to Minckley (1973), the humpback sucker is believed to be nearing extinction below Lake Mojave and is concentrated upstream of the proposed pipeline crossing in the Colorado River. Therefore, although individuals of the bonytail chub, Colorado squawfish, or humpback sucker possibly still exist below the crossing, the likelihood that they would be encountered during pipeline construction or oil spill is remote (Bailey and Moore, 1976: pers. comm Univ. Mich. Mus. Zool., and Okla. State Univ., respectively).

Several protected bird species are known to inhabit or occasionally visit the Colorado River and surrounding environs during some time of the year. Infrequent visitors are the California brown pelican, southern bald eagle, and American peregrine falcon which are classified as Endangered by the Federal Government. One or more states along the proposed route also have classified these birds as Endangered (Table 2.1.8.3-1). The white-fronted goose, another infrequent visitor, is considered Threatened by the Federal Government.

Three birds having a protected status are local residents of the lower Colorado River. The Yuma clapper rail is considered Endangered by the Federal Government and the states of California and Arizona. The California black rail is on the Federal Endangered list, classified as Rare by California, and Endangered by Arizona. The yellow-billed cuckoo is also classified as Rare by California. If a major oil spill were to occur, all of these species would suffer some loss of habitat. Local population reductions would undoubtedly follow.

In the Yuman Desert Biome the desert bighorn sheep, considered Threatened in Arizona, is well established in the Dome Rock Mountains. The pipeline route passes directly through some of the best sheep country in this range. An oil spill would effectively remove anywhere from 1 to 10 acres from production. Since the sheep utilize the cliff adjacent to the existing pipeline for reproductive purposes, clean-up crews would disrupt these activities, possibly contributing to a smaller lamb crop that year.

Desert bighorn sheep are also found in the Castle Dome and Kofa mountains in the Kofa Game Range. Where the line passes through the Kofa Game Range minimal impacts on the sheep would be likely since they utilize the existing pipeline corridor area very little. This probably results in part from the number of recreationists using that area. The desert rosy boa, considered Threatened by Arizona, is also found in the Castle Dome and Kofa mountains and could be encountered in that area if an oil spill were to occur, resulting in the direct loss of individual species and removal of prey habitat.

The Gila River is crossed by the existing pipeline in the Yuma Desert Biome. Fish species having a protected designation, which might still be found in the Gila River, include the spikedace, on the New Mexico and Arizona Threatened lists, and the Gila topminnow, on the Federal Government and New Mexico Endangered lists. It is somewhat doubtful the Gila topminnow still exists near the proposed crossing since recent surveys have not been able to locate this species.

In the Arizona Upland Desert Biome, the spikedace also has been recorded in the San Pedro River. Other protected vertebrates which live in this biome include the Gila monster, on the Arizona Threatened list and New Mexico Endangered list, and and Arizona coral snake, considered Threatened in Arizona. All could be impacted by an oil spill either by being killed directly by oil or indirectly by loss of habitat.

At Willcox Playa in Sulphur Springs Valley, in the adjacent San Simon Valley in Arizona, and along the Pecos River and the Rio Grande, the highest concentrations of Mexican duck populations in the United States are found. The Mexican duck is on the Federal, New Mexico, and Texas Endangered lists, and the Arizona Threatened list. A Mexican duck sanctuary has been established on the east bank of Willcox Playa, which is about 10 miles from the pipeline, to assist in the preservation of this bird. An accidental oil release into the playas or marshes in those areas could be extremely detrimental to this Endangered species. Severin Wash and Long Canyon Wash are crossed by the pipeline and drain into Willcox Playa. Willcox Playa would undoubtedly be affected by an oil spill if water was flowing in either of these washes and oil entered them. Also, if the water table were contaminated, aquatic habitat would be impacted where the contaminated water surfaced, resulting in further habitat and population reductions of an already limited species.

Although, the coatimundi, jaguarundi, and ocelot could potentially be encountered in the southwestern deserts, it is unlikely that they would be impacted by the proposed project.

The Rio Grande and Pecos River in the Chihuahuan Desert provide suitable habitat for several species on protected lists. Fishes include the proserpine shiner, found in both waters, and the Pecos pupfish, found in the lower Pecos River. Both species are considered Endangered by New Mexico. Another fish, the gray redhorse, although not under a special protective designation at this time, has only three known populations in New Mexico. The Pecos River and Red Bluff Reservoir below the proposed Pecos River crossing are two of the locations where the fish is found; the other (Black River) is not near the pipeline route. An oil spill in either of those waters would effectively reduce the available habitat for from 3 to 10 years, depending on the amount of oil spilled and effectiveness of cleanup, thereby reducing or even eliminating these populations. Several reptiles, the Texas slider, Pecos ribbon snake, and the blotched water snake, all on the New Mexico Threatened list, also have been found along the Pecos River. An oil spill would impact those species in the same manner.

3.1.9 Cultural resources

3.1.9.1 Historic

Port of Long Beach area

The proposed action would not affect any known resources that are in, or eligible for, inclusion in the National Register of Historic Places in the Port area.

Pier J -- Los Angeles River

Effects on resources in this reach should be minor. Because the proposed pipeline would pass along the east (south) bank of the Rio Hondo channel, it would intersect the line of the American military attack of January, 1847. This is a historically sensitive area. For years after the battle, local residents reported digging up military hardware. The value of this site is in its location, and it is not expected that the proposed action will diminish the value of the location as a cultural resource.

Whittier Narrows Dam

The integrity of the Whittier Narrows area was largely lost during construction of the dam. Because of this disturbance, few, if any, additional impacts are expected to occur.

San Jose Creek

Because San Jose Creek channel has been moved northward several hundred yards and construction of the intersection of the Pomona (No. 60) and San Gabriel River (No. 605) freeways has substantially disturbed the local terrain, the proposed pipeline would have no anticipated effect on the Workman Mill site.

3.1.9.2 Cultural and paleontological resources -- pipeline route

3.1.9.2.1 Conversion/construction

Direct impacts to cultural/paleontological resources resulting from new pipeline construction potentially would occur along 83 miles of the pipeline route from Pier J to Beaumont, California; 29 miles from the Ford Dry Lake in Chuckwalla Valley, California, to the Colorado River; 6 miles from the Colorado River to the Ehrenberg Pump Station, Arizona; 34 miles from a point about 9 miles inside the Kofa Game Range western boundary to 7 miles northwest of Eagletail Mountain in Arizona; and 71 miles from Jal, New Mexico, to Midland, Texas. These distances are approximate, but should be accurate to within one-half mile.

Impacts also would occur where there would be new access roads, borrow areas for roadfill and pipe-bedding materials, disposal areas for excess soil and other materials removed from the right-of-way, pipe-storage areas, construction camps, removal and discharge of water for pipe integrity testing, new pump station sites, and power lines to the pump stations. Accidents such as oil spillage also may have an adverse impact on sites.

Archaeological and historical sites and impacts

Archaeological and historical sites are sensitive to any disturbance, since the position and patterning of the remains and the surrounding environment are used for analytical purposes. Alteration or disturbance of these associations and patterns is detrimental to the integrity of the site and its potential scientific and educational value. Data loss is directly proportional to the amount of disturbance and the character of the site. Fragile surface sites which characterize much of the Southwest are particularly vulnerable to almost any activity, from construction to vehicular traffic.

Mitigation of impacts by scientific excavation and collection also is a direct impact since more advanced techniques for investigation may be developed at a later time which would have yielded more knowledge of the site. However, the adverse impacts of total loss of the site far exceed those which may result from a particular recovery technique.

Indirect impacts from this project, which can be as damaging to the resource base as direct impacts, may result from road construction which serves as a catalyst for (1) increased ORV access and disturbance, (2) increased visitor use, and (3) knowledge of identified resources which results in vandalism and relic hunting.

Other sources of indirect impacts include visual intrusions on the aesthetic quality and surrounding environment of the site, and subsequent developments that are precipitated by the proposed project. The cumulative effect of all impacts is of particular concern when evaluating impacts on the resource base.

Throughout the proposed pipeline system, site inventory data are inadequate for accurate or complete evaluation and quantification of potential effects and impacts. Because potential damage and/or destruction is not limited to rights-of-way and areas of direct construction-related disturbance, it must be assumed that any site within an arbitrarily defined influence zone of 5 miles might suffer damaging impact. In some cases, this zone might vary from 1 to 30 miles in width. For the most part, these impacts on the resource are incremental.

Variables considered in establishing impact levels on cultural resources include the inherent sensitivity of sites to construction disturbances, the condition or extent of existing disturbance, the number or areal extent of sites potentially disturbed and their locations, and the duration of impact.

Resource sensitivity. The sensitivity of cultural remains to physical destruction varies somewhat, depending on the type of sites, their potential distribution and status, and their location with respect to the subject activities.

Surface sites such as trails, cairns, or stone circles are the most vulnerable to direct impact because of their fragile nature. However, they can be avoided because of the relatively great distances separating most of them and their confined localities. The potential of disturbance during construction is greater in areas of more densely concentrated sites.

The sensitivity of rock art sites is variable depending on their type. Petroglyphs are usually found on boulders or in association with shelter caves or foothills, and thus are more easily avoidable than ground sites. Intaglios are ground-level figures in gravel areas of desert pavement and are more susceptible to disturbance.

Zones of known dense and diverse site distributions facilitate the prediction of presently unknown site densities in contiguous areas of similar environment. Virtually all other areas will remain unknown until surveys are completed.

Condition or extent of existing disturbance. Disturbances to cultural resources from cultivation, urbanization, or other development have often modified or even eliminated the potential of these resources to be additionally impacted by the pipeline or other construction. Use of existing access roads for construction activities also would reduce potential impacts.

The number or areal extent of sites potentially disturbed by the pipeline or other construction is measured by predicted site density as well as site distribution, or simply by impressions based on examining the environment and extrapolating from known areas.

Duration of impact. Archaeological remains are considered a nonrenewable resource, making any direct physical impact a long-term, irretrievable commitment of resources. This makes the destruction of any cultural resource a significant impact, and some have more value than others.

Paleontological sites and impacts

No effects on paleontological resources of the Port of Long Beach are expected.

Fossiliferous deposits occurring along the pipeline route would be subject to both direct impacts from roads and pipeline construction, and indirect impacts from the collectors and noncollecting users attracted by new access routes. Direct impacts can be expected in areas of surface and near-surface fossil-bearing material from grading for access roads and construction laydown areas. Some direct impact would occur to subsurface fossils from trenching for the new line.

Indirect impact would be expected primarily from possible exposure of new fossil beds because of grading or other surface work. Also, collectors would become more active where access is improved. Additional indirect impact to surface fossils adjacent to the pipeline route would be expected from use of off-road vehicles, particularly near construction areas.

Impacts from surface disturbances or from vandalism could result in complete loss or destruction of scientifically valuable paleontological finds along the proposed system. After construction, access roads would probably be subject to long-term soil erosion and continuing fossil-bed exposure because of continued use by maintenance and recreational vehicles. The greatest impacts would be expected along those portions of the proposed system requiring new construction.

The overall impact to areas having invertebrate fossils would likely be minor because (1) trenching for placement of new pipe would affect only a very small portion of any fossil-bearing deposit; (2) surface and near-surface fossils may be weathered to the extent that they have lost direct scientific value, and (3) a major portion of the pipeline system would use the existing natural gas pipeline, thereby reducing the potential for new indirect impact and eliminating some direct impact from new road construction.

Potential disturbance to vertebrate fossil sites as identified in Chapter 2 would be much higher since vertebrate remains are normally significantly localized and less common. Any such find can be considered of primary scientific importance.

A possible beneficial impact would result if construction-related exposure of previously unknown and unstudied fossil deposits could add to the existing paleontological data base.

Summary of cultural impacts by location

To facilitate discussion of impacts on cultural resources, a description of known or predicted impacts by links or segments is presented. In some cases there is nothing more than the best available estimate. In other cases no evaluation is possible until further fieldwork is undertaken.

West Coast to Dominguez Hills terminal

Because of the extensive urbanization, few cultural resources have been identified in the area. Although further evaluation following fieldwork is necessary, overall impacts are predicted to be low. Point Fermin Lighthouse and Battery Osgood-Farely (National Register of Historic Places) and Timm's Point, the S.S. Catalina, and Port Los Angeles Long Wharf (California State Historic Landmarks) could be adversely impacted in the event of an oil spill in or near the port area. Oil washing ashore at or near these sites would result in low to high adverse aesthetic impacts, depending on the specific location and magnitude of the spill.

The possibility of the presence of cultural resources associated with bottom sediments in the port, and their recovery potential, is considered remote.

However, any resources which may be present in the area to be dredged would be lost.

Dominguez Hills terminal to Redlands Pump Station

This segment of the proposed new construction contains many cultural sites, a number of which are on the National Register of Historic Places. Several are located on the proposed line and an equal number are situated nearby. Both direct and indirect impacts can be predicted as a function of proximity to the proposed route and would be significant. Excavation near the village sites referenced in Chapter 2.1.9.3 could disrupt subsurface resources in the area.

Redlands to Indio Pump Station

Within this segment, the portion from Redlands to Beaumont would necessitate new construction. From Beaumont to the Indio Pump Station, the existing Southern California Gas Company pipeline would be utilized. This segment represents perhaps the best documented archaeological area of the entire route. At least 54 cultural-resource sites have been recorded, many close to the existing route. In the Indio vicinity, portions of four aboriginal trail segments cross the existing line. The historic village of Sahatapa is a designated California State Historic Landmark, representing the only historic property within this segment. Both direct and indirect impacts from new construction probably would be high. Present data indicate that impacts along the remaining section would be low.

Indio to Desert Center Pump Station

One potential National Register of Historic Places District is the World War II training area of Camp Young, Hayfield. Petroglyphs and several aboriginal trail segments with associated pottery scatters are representative of the cultural resources present in this section of the route. Overall impacts might be moderate. Although the route calls for an existing pipeline in this segment, new transmission lines would impact the camp.

Desert Center to Ehrenberg Pump Station

New pipeline would be necessary from Ford Dry Lake to the Colorado River. Several potential National Register of Historic Places Districts are included in the 30 or more archaeological sites in this segment. The potential National Register properties at Ford Dry Lake, Mule Mountains, McCoy Mountains and along both sides of the Colorado River are situated along a portion of the route requiring new construction. Overall impacts would be mostly indirect because of the property locations in relation to the right-of-way, but construction could result in major damage to an individual site.

Ehrenberg to Livingston Pump Station

This short segment would utilize existing line and contains only one reported archaeological site and three historical sites. Predicted impacts for this section are assumed low, but empirical data must be gathered during survey to more properly assess impacts.

Livingston to Eagletail Mountains

A moderate density of sites can be predicted near French Creek and the Near Water Mountains. Since the majority of this segment calls for new construction, impacts could be high if sites are encountered.

Eagletail Mountains to Gila Pump Station

One village site has been reported by survey crews from Arizona State University (ASU) in the vicinity of Centennial Wash. Other ASU surveys in the area revealed few sites. Since existing line would be used in this segment and apparently few sites are present, impacts to cultural resources probably would be low.

Gila to Casa Grande Pump Station

The Haley Hills archaeological site represents the only reported cultural property within this segment, although many sites are predicted to be present. Anticipated impacts should be low in this section since existing line would be used.

Casa Grande to Coolidge Pump Station

Five archaeological and three historic sites are recorded in this section. Other sites are predicted to be present. Direct impacts to cultural resources in this segment should be minimal since existing pipeline would be utilized. Other impacts cannot be assessed at this time.

Coolidge to Black Mountain Pump Station

The Tom Mix Monument represents the only known cultural property in this short segment. Since existing line would be used, direct impacts should be minimal.

Black Mountain to Redington Pump Station

Two major archaeological sites, two historic sites, and a portion of one historical route comprise the known cultural resources for this segment.

Direct impacts should be minimal since existing line would be utilized in this segment.

Redington to Cochise Pump Station

Cultural resources within this portion of the corridor include two archaeological sites, 14 historic sites, and portions of one historic route. Direct impacts should be low because existing gas pipeline will be used, but the degree of indirect impacts is unknown. However, depending on the exact location of the Redington Pump Station and the proposed construction access road, archaeological sites could be encountered and disturbed in this archaeologically sensitive area.

Cochise to Lordsburg Pump Station

At least three archaeological sites, two historic sites, and portions of four historic routes are associated with this segment of the corridor. Direct impacts to known cultural resources should be low if existing line is used. Indirect impacts or direct impacts resulting from ancillary construction are unknown.

Lordsburg to Deming Pump Station

One potential National Register village site and seven temporary camp sites are recorded in this segment. One historic site and a portion of a historic route are also known. Assuming conversion of the existing gas pipeline is confined to the present right-of-way, anticipated impacts to the known cultural resources should be low.

Deming to Anthony Pump Station

Direct impacts to cultural resources along this segment can be kept to a minimum by utilizing the existing pipeline. However, the area must be considered archaeologically sensitive, especially along the Mimbres River and the Rio Grande. No judgment of secondary impacts or direct impacts from auxiliary construction activities can be predicted accurately until surveys are completed.

Anthony to El Paso Pump Station

Since a number of significant sites near the sensitive Rio Grande have been identified for this segment, some impacts, possibly only visual, are expected. However, the exact nature of ancillary construction and consequent direct impacts are presently difficult to assess. Based on existing data, direct and indirect, potential impacts may range from moderate to high.

El Paso to Guadalupe Pump Station

It is difficult to judge the potential for impacts on cultural resources because of the inadequacy of survey information. The Hueco Tanks petroglyphs may sustain visual impacts. However, no other impact can be accurately predicted.

Guadalupe to Pecos River Pump Station

No direct impacts on cultural resources should result if existing lines are used. Auxiliary construction, however, could impact sites predicted for this segment. The effects of indirect impacts cannot be determined, but the potential for high impacts should be considered for this segment.

Pecos to Jal

The known data base for this segment includes two historic sites and five aborginal sites. Pope's Wells historic site (2 separate locations) has been nominated to the National Register of Historic Places. Both wells are located approximately 2 miles from either side of the proposed pipeline alignment, hence, conversion of the existing pipeline in this segment should not directly or indirectly impact this major historic site. No direct impacts to the remaining six known sites recorded for this link are anticipated since no additional surface disturbing activities are anticipated, as a result of pipeline conversion within the confines of the presently extablished right-of-way. Indirect impacts in the form of aesthetic degradation of site integrity is a possibility.

Jal to Midland terminal

Within this final segment, 18 historic sites have been recorded. Twenty-seven archaeological sites, including probable National Register Districts, are included in the inventory. Extrapolation of site data recorded from recent surveys of the original alignment between Jal and Midland indicate that many additional sites may be predicted for this sensitive segment.

Both direct and indirect impacts to this final section can be predicted as high, pending a more thorough archaeological survey of the new alignment.

No assessment of impacts from ancillary construction can be derived until further overviews and surveys are completed along the entire system.

3.1.9.2.2 Operation

Operation and maintenance of the proposed pipeline would either perpetuate or modify local envirnomental alterations created by previous construction activities.

Vehicle activity off roads, an oil spill, renewed construction, repair and any alterations of facilities, or activities affecting previously undisturbed lands could have potentially adverse effects on cultural or paleontological values.

3.1.10 Visual resources

3.1.10.1 Sea Leg and Port of Long Beach

Santa Catalina Island

On Santa Catalina Island the Pebbly Beach Quarry will be enlarged in both operation and acreage disturbed to supply 2.5 million tons of rock for the breakwater to protect the tanker trestle berths at the Port of Long Beach. The increased activity including blasting, bulldozing, and loading of barges will be highly visible and disturbing to both visitors of the Avalon resort community and ocean boaters and fishermen offshore of Santa Catalina Island.

The quarry face, already 500 feet above the shore, will be extended another 100 to 200 feet or more higher in elevation making the quarry scar more visually prominent than ever. The light-colored rocky contours of the quarry will have a high contrast with the natural landforms and the light-colored scar will contrast sharply with the subdued colors of the surrounding brushland vegetation. Reshaping of the quarry surface and revegetation is not likely within the foreseeable future; the quarry enlargement thus represents a long-term visual degradation of this highly scenic and visually sensitive island.

Based on an analysis of the project in terms of policies and guidelines for coastal appearance in the California Coastal Plan, the proposed project will have visual impacts, primarily from the six storage tanks to be located on Pier J (see Figure 3.1.10.1-1).

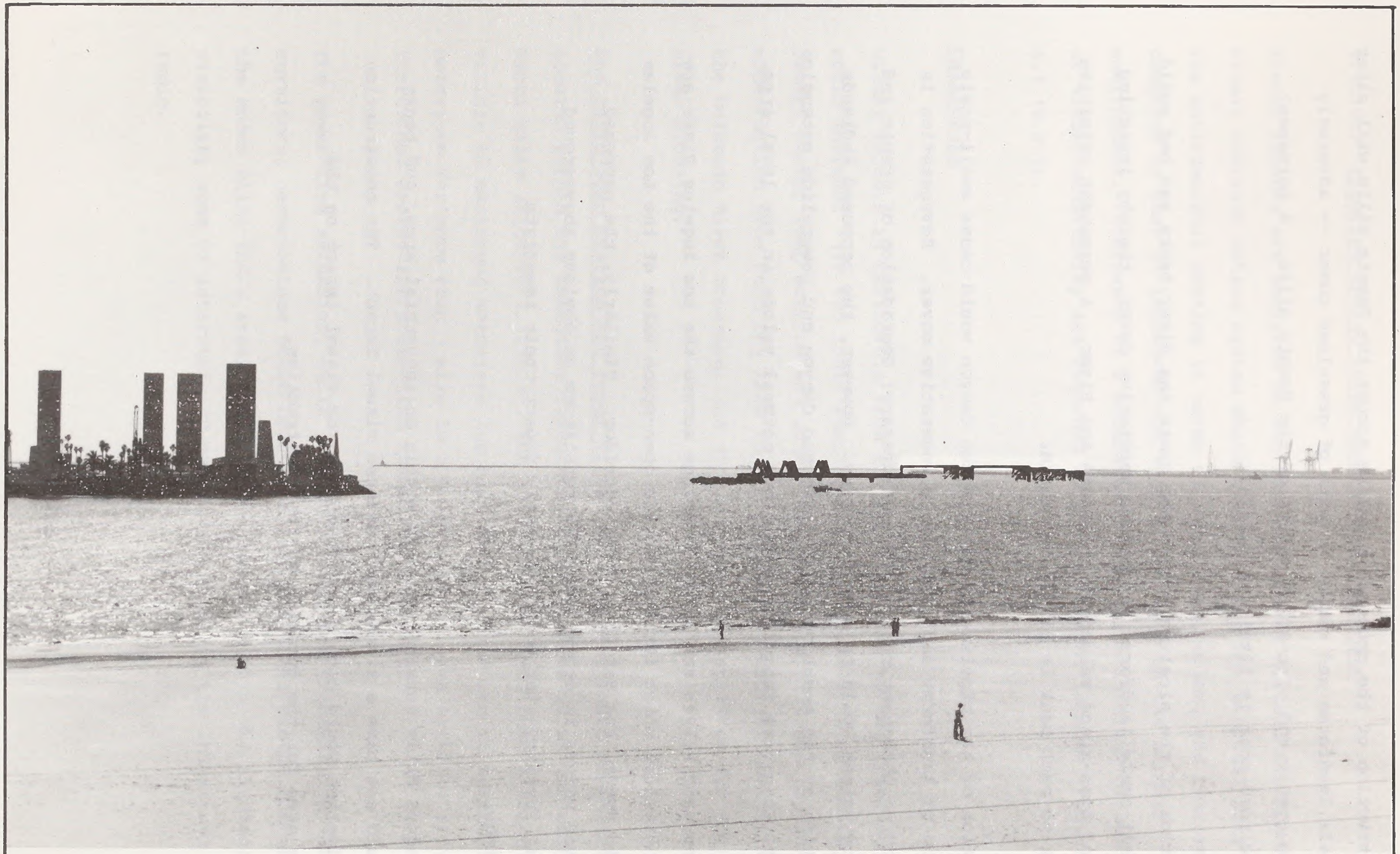
The size of the storage tanks in terms of height and bulk would compete with the Queen Mary and gantry cranes for visual dominance of Pier J as seen from both the Long Beach shoreline and San Pedro Bay east of Pier J. The proposal to locate storage (inventory) tankage on Pier J conflicts with the Coastal Plan's visual resource Guideline No. 56, which states that industrial facilities, not requiring water or oceanfront location, should not be located in the oceanfront area; i.e., only surge tankage required due to differential between tanker off-loading rate and pipeline throughput capacity to an inland storage terminal should be located in the coastal zone.

The tanker unloading trestles appear to fit visually into the Port atmosphere.

Any oil spills in the harbor which are not boomed and cleaned up are likely to wash up on Long Beach beaches. Major oil spills would severely degrade the scenic quality of the beach until cleaned up. Smaller spills are likely to end up as "tar" (weathered oil and sand globules) on Long Beach beaches.

3.1.10.2 Pipeline route, greater Los Angeles urbanized landscape

Visual impacts from the project in the greater Los Angeles urbanized landscape would include: (1) impacts on scenic and open space values of the Puente Hills, Santa Ana River, and San Timoteo Canyon, (2) impacts of valves and pipeline bridging on the open-space value of Los Angeles River, Rio Hondo, and San Jose Creek, and other urban areas, and (3) temporary visual impacts resulting from construction activity.



CONCEPTUAL PRESENTATION

Figure 3.1.10.1-1 Proposed oil storage tanks on Pier J as seen from Long Beach shoreline

The construction of the proposed pipeline across the Puente Hills will alter small-scale landforms and remove a swath of grassland cover -- adversely affecting scenic and open-space values of the Puente Hills. A permanent primitive road scar is likely to remain.

Construction of the pipeline across the Santa Ana River banks and bed would alter small-scale landforms and remove vegetative cover, thereby impacting scenic and open-space values of the Santa Ana River. A permanent primitive road scar to each bank is likely to remain.

Construction of the pipeline in San Timoteo Canyon would cause small-scale alteration of landforms and also remove vegetative cover. Revegetation is likely and no permanent road would be necessary; degradation of scenic and open-space values would be only temporary. However, the proposed Redlands Pump Station at the mouth of the San Timoteo Canyon and power-line extension constitute long-term impact on scenic and natural values in the local area.

The aboveground valves and pipeline bridge across the Los Angeles River are visual intrusions which further degrade open-space value of the Los Angeles River, Rio Hondo, and San Jose Creek corridor. Similarly, the proposed aboveground valves in other locations constitute an obvious aboveground industrial facility that would adversely impact their immediate surroundings.

The Dominguez Hills terminal site is within an industrial area, and tanks there would not have a significant adverse visual impact. The construction of the pipeline would have a temporary adverse visual impact on the immediate area for the duration of the construction.

3.1.10.3 Pipeline route, rural and natural landscape

Visual impacts are analyzed on the basis of Bureau of Land Management's visual contrast rating system which evaluates how the proposal fits within its environmental setting in terms of form, line, color, and texture, compared to that of landforms and vegetation found in the natural environment. Contrasts of a moderate-to-high value in areas of scenic value or visual sensitivity are regarded as adverse visual impacts (Figure 3.1.10.3-1).

California

Visual impacts in California from San Gorgonio Pass to the Colorado River would include: (1) the Indio Pump Station and power-line extension, (2) Desert Center Pump Station and power-line extension, (3) new pipeline construction from Ford Dry Lake to the Colorado River, (4) construction of the Colorado River crossing, and (5) potential oil spill on the Colorado River crossing.

The Indio Pump Station and power line. The proposed Indio Pump Station is located within the immediate foreground of Interstate 10 in the colorful Mecca Hills (Figures 3.1.10.3-2 and 3.1.10.3-2A). The pump station would be visible to eastbound motorists for more than 5 miles and to westbound motorists for more than 1 mile in a scenic desert area with few aboveground intrusions except for power-line transmission towers.

The power-line extension, while it follows existing transmission line corridors, nevertheless would constitute a significant visual intrusion on the Mecca Hills-Indio area, and would be largely within the middleground visibility zone of Interstate 10 motorists, crossing the Interstate near Indio.

Degree of contrast with natural desert environment viewed in foreground — middleground

3 = High

2 = Moderate

1 = Low

0 = None

			PUMP STATION	POWER-LINE EXTENSION	PIPELINE SCAR
VISUAL CONTRAST ELEMENTS	FORM	(weight 4)	x2 = 8	x1 = 4	x1 = 4
	LINE	(weight 3)	x1 = 3	x3 = 9	x3 = 9
	COLOR	(weight 2)	x3 = 6	x2 = 4	x2 = 4
	TEXTURE	(weight 1)	x2 = 2	x1 = 1	x2 = 2
VISUAL CONTRAST RATING*			19	18	19

*Maximum permissible:
10—Areas of high scenic quality A & B in FG
16—Areas of high visual sensitivity B quality in BG & MED sen. in FG.
20—Other areas

Figure 3.1.10.3-1 Determination of adverse visual impacts — rural and natural landscapes

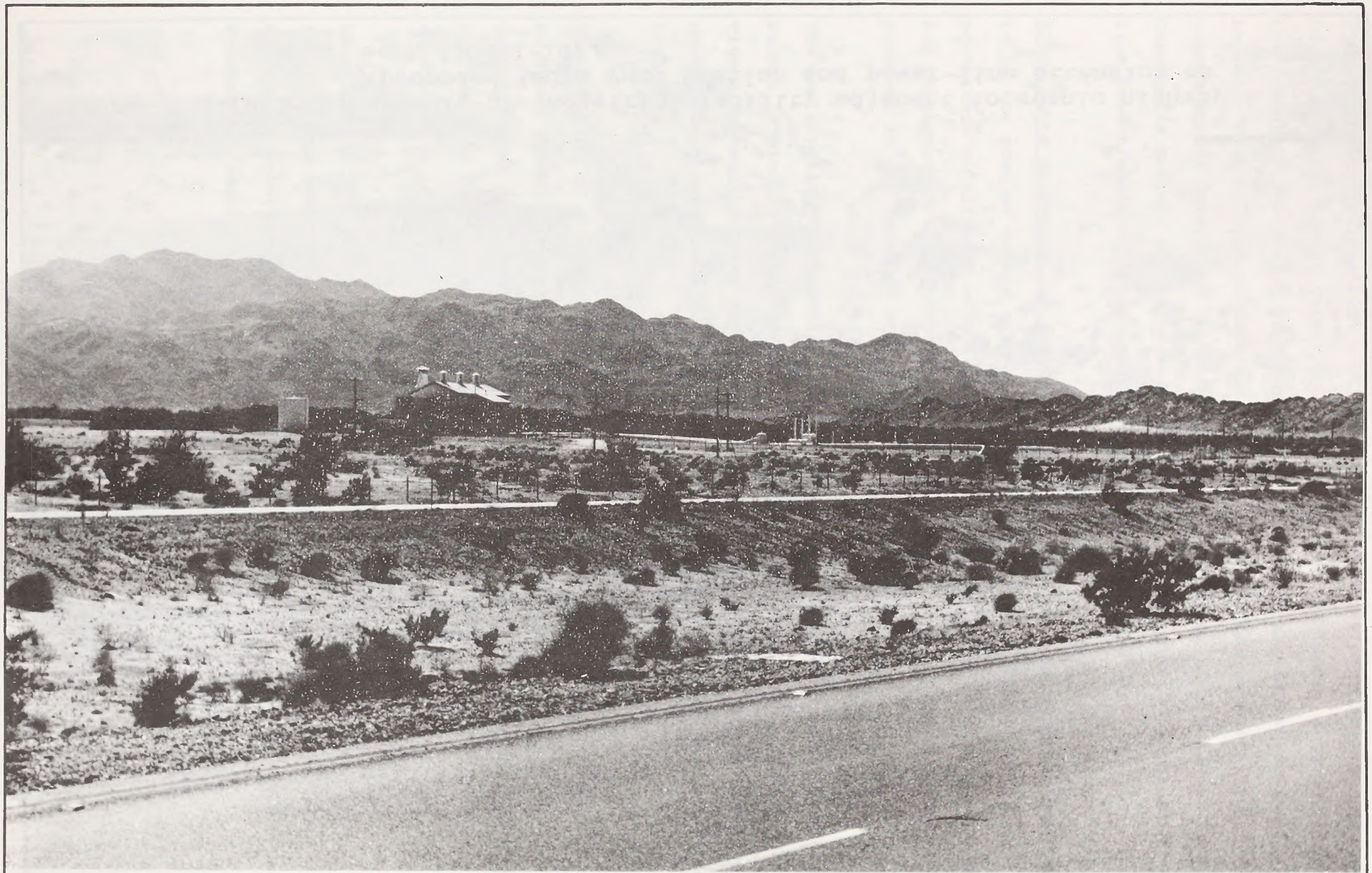


Figure 3.1.10.3-2 Example of industrial facility adjacent to scenic highway (natural gas compressor station near Chiriaco Summit as seen from I-10)

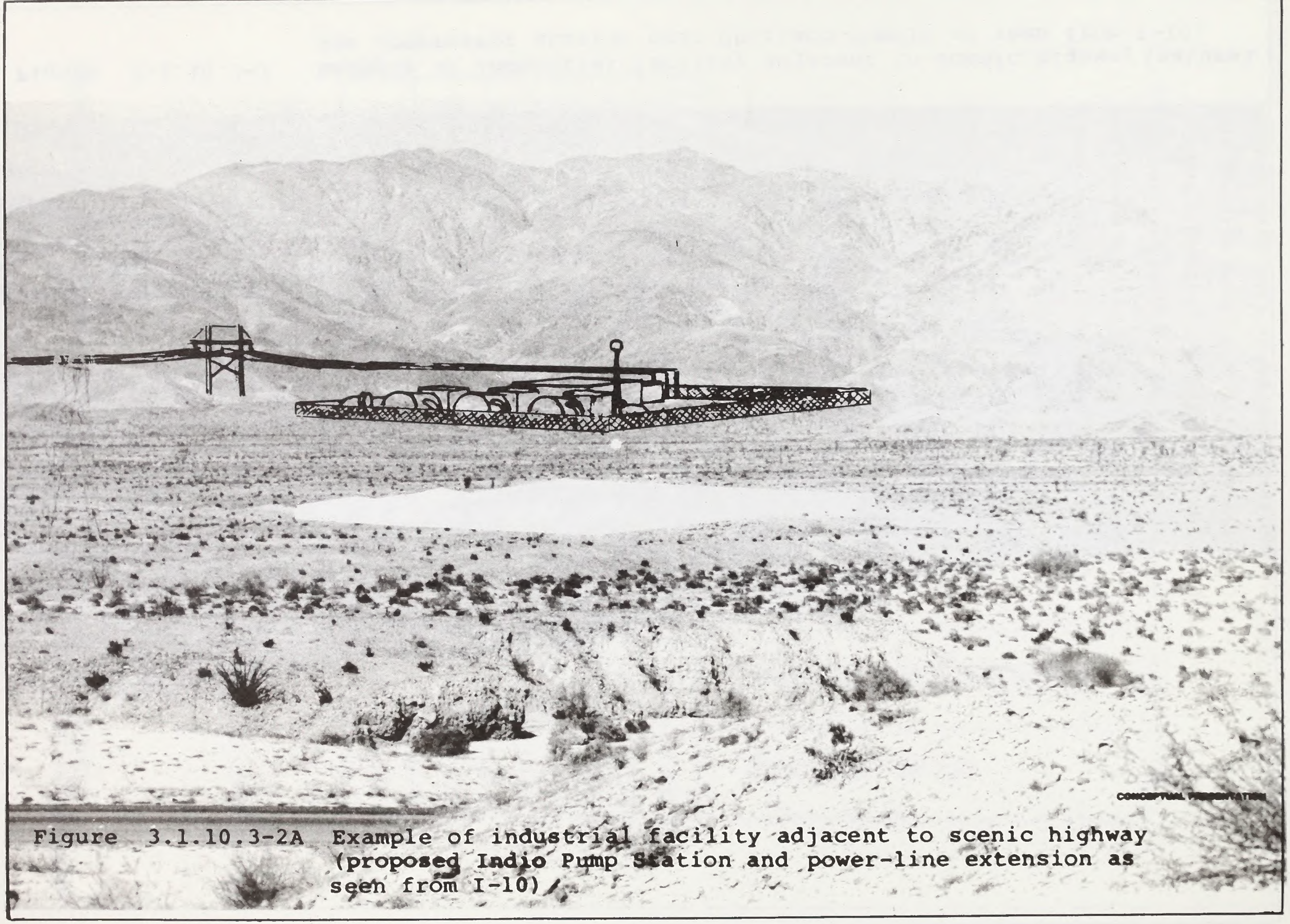


Figure 3.1.10.3-2A Example of industrial facility adjacent to scenic highway (proposed Indio Pump Station and power-line extension as seen from I-10)

Desert Center Pump Station. This station location is immediately adjacent to the existing Desert Center compressor station and hence, although within the immediate foreground of Interstate 10, would be a relatively minor impact. However, the power-line extension to serve the pump station is routed across Interstate 10, a desert access road, and near a scenic area of Chuckwalla Valley, noted for its floristic display. The resultant power-line impact would be relatively severe (Figure 3.1.10.3-3).

Black Butte microwave repeater station. The site of this repeater station is in the area of scenic value and visual sensitivity. This could constitute significant adverse visual impact. Any power line or access road for construction/maintenance would further compound the problem (applicant's proposal is too vague to precisely define impacts).

The new pipeline construction from Ford Dry Lake to the Colorado River would result in minimal visual impact as much of it would not be visible from any visually sensitive area including Interstate 10, and much of the proposed route across the desert is in an area crisscrossed with recreational vehicle trails.

Construction of a submerged crossing of the Colorado River near Blythe would no doubt visually increase the sediment load of the Colorado River downstream of the crossing to the Imperial Dam, thereby degrading the visual character of this popular recreational reach for the duration of the construction period.

An oil spill from the submerged river crossing could potentially reach Imperial Dam before cleanup began. Riparian shoreline vegetation might be destroyed, creating an unsightly area along the river until vegetation could reestablish itself.

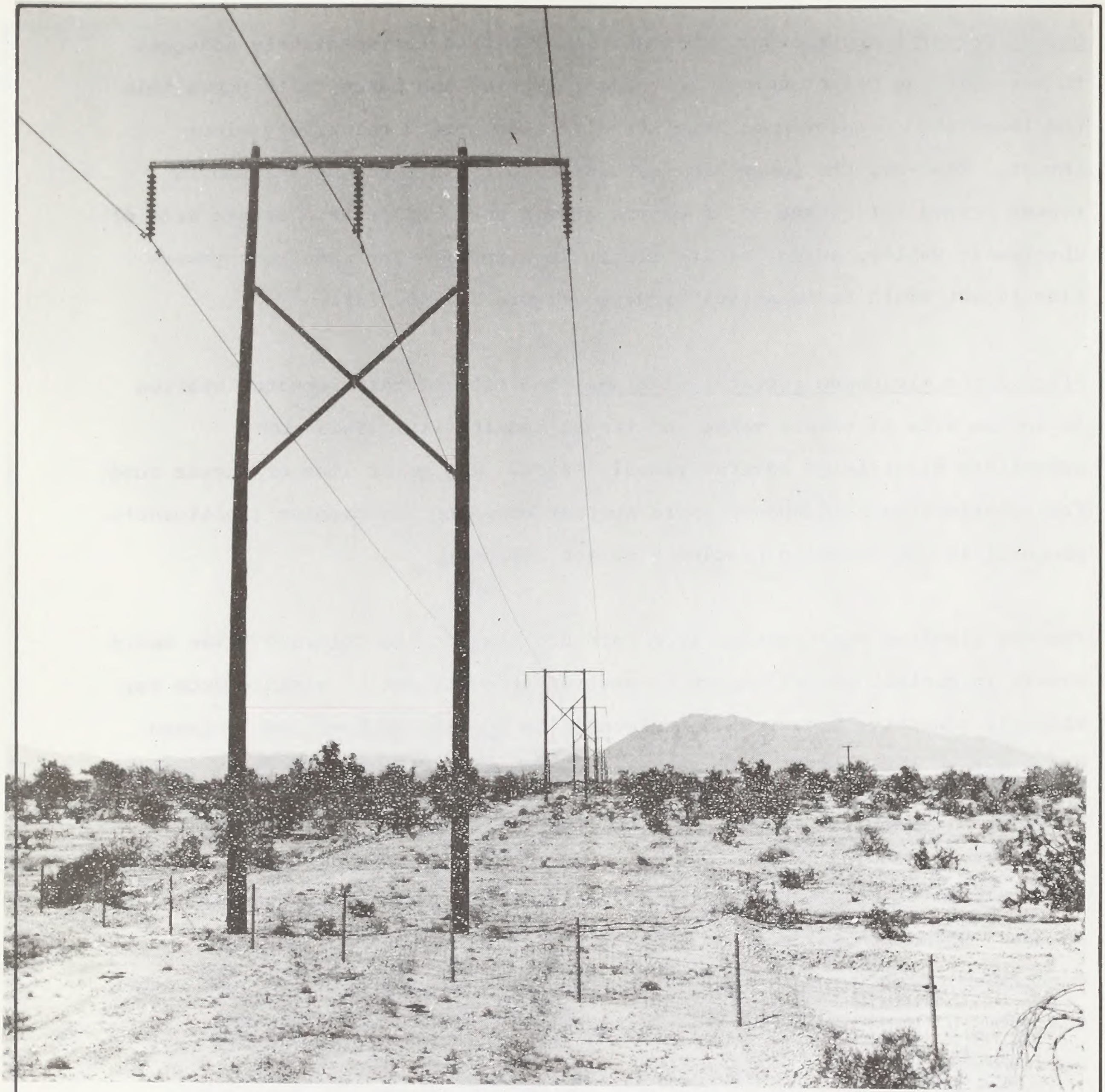


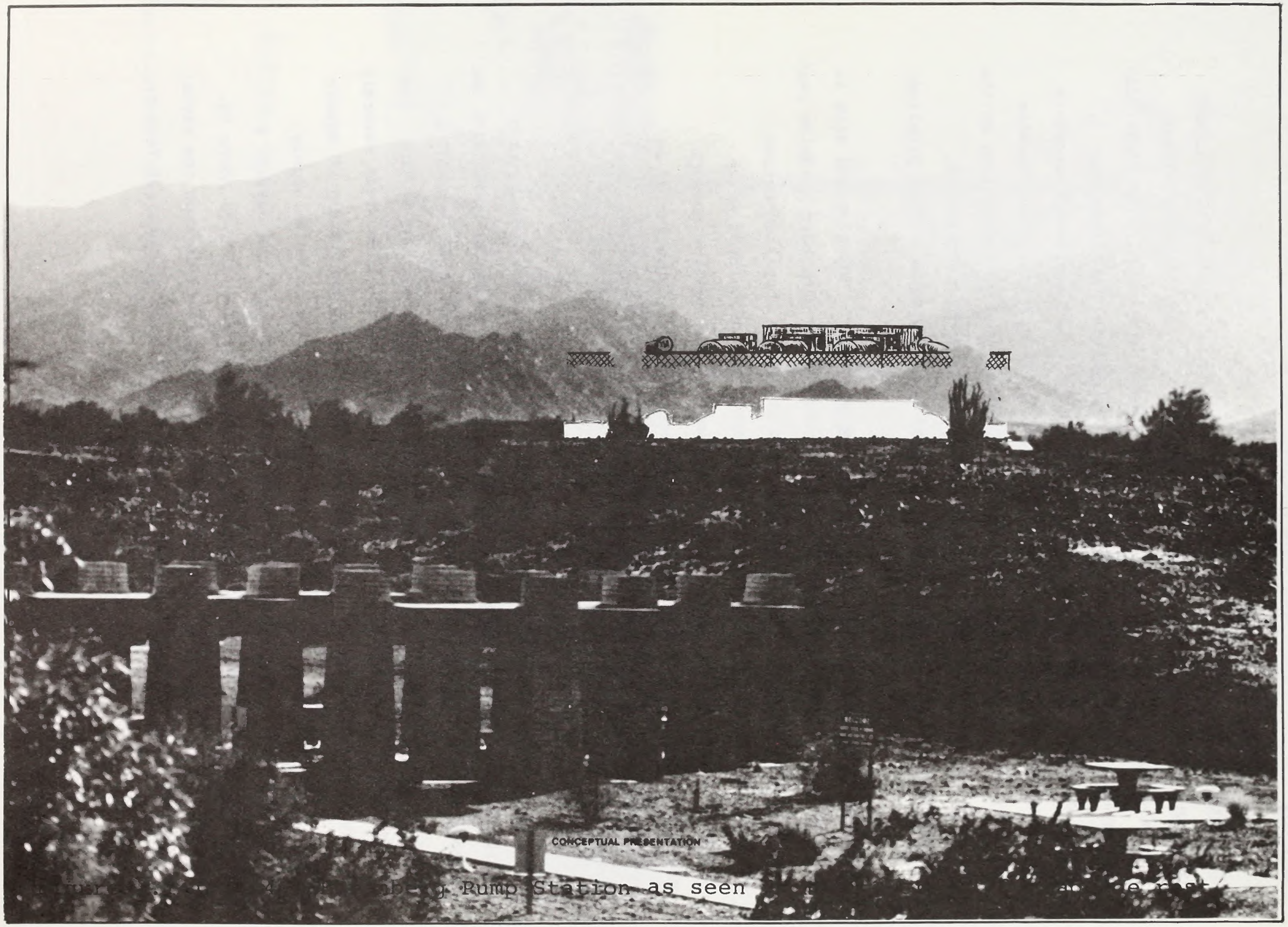
Figure 3.1.10.3-3 Example of power-line impact analogous to proposed Desert Center power-line extension (69 kv line east of Desert Center in Chuckwalla Valley)

Arizona

New pipeline construction from Colorado River crossing to Ehrenberg Pump Station. This new pipeline construction would create long-term visual impact across the desert pavement and brushland vegetation. The first mile of the new pipeline corridor would be visible within the foreground visibility zone for Colorado River recreationists and eastbound motorists crossing the Interstate 10 bridge over the Colorado River. Construction activity would be visible to interstate motorists and recreationists on the Colorado River. The pipeline would reduce the open-space value of approximately 6 square miles of lands immediately adjacent to the pipeline.

Ehrenberg Pump Station site and power-line extension. The proposed site is located within the foreground visibility zone of the Ehrenberg roadside rest area on Interstate 10. This roadside rest area with its interpretive displays and picnicking ramadas is surrounded by public lands which typically would ensure maintenance of present scenic quality through provisions of the Highway Beautification Act of 1965. Location of an industrial facility within .25 mile would impact the scenic and open-space values of this roadside rest area (Figure 3.1.10.3-4).

The proposed 16-mile power-line extension to the Ehrenberg Pump Station utilizes the existing pipeline corridor to cross the Dome Rock Mountains and La Posa Plain. The Dome Rock Mountains and the La Posa Plain west of U.S. Route 95 are presently unencumbered by overhead power-line intrusions. The proposed power line would be a visually dominant feature that would severely degrade the present scenic and open-space values on approximately 48 square miles. The western 2 miles of the proposed power line would be highly visible from approximately 5 miles of Interstate 10 while the eastern 6 miles would be highly visible from approximately 8 miles of U.S. Route 95. The power line for 6 miles across the La Posa Plain would degrade the visual environment of a popular "snowbird" winter camping area (Figure 3.1.10.3-5).



[illegible] Pump Station as seen [illegible]

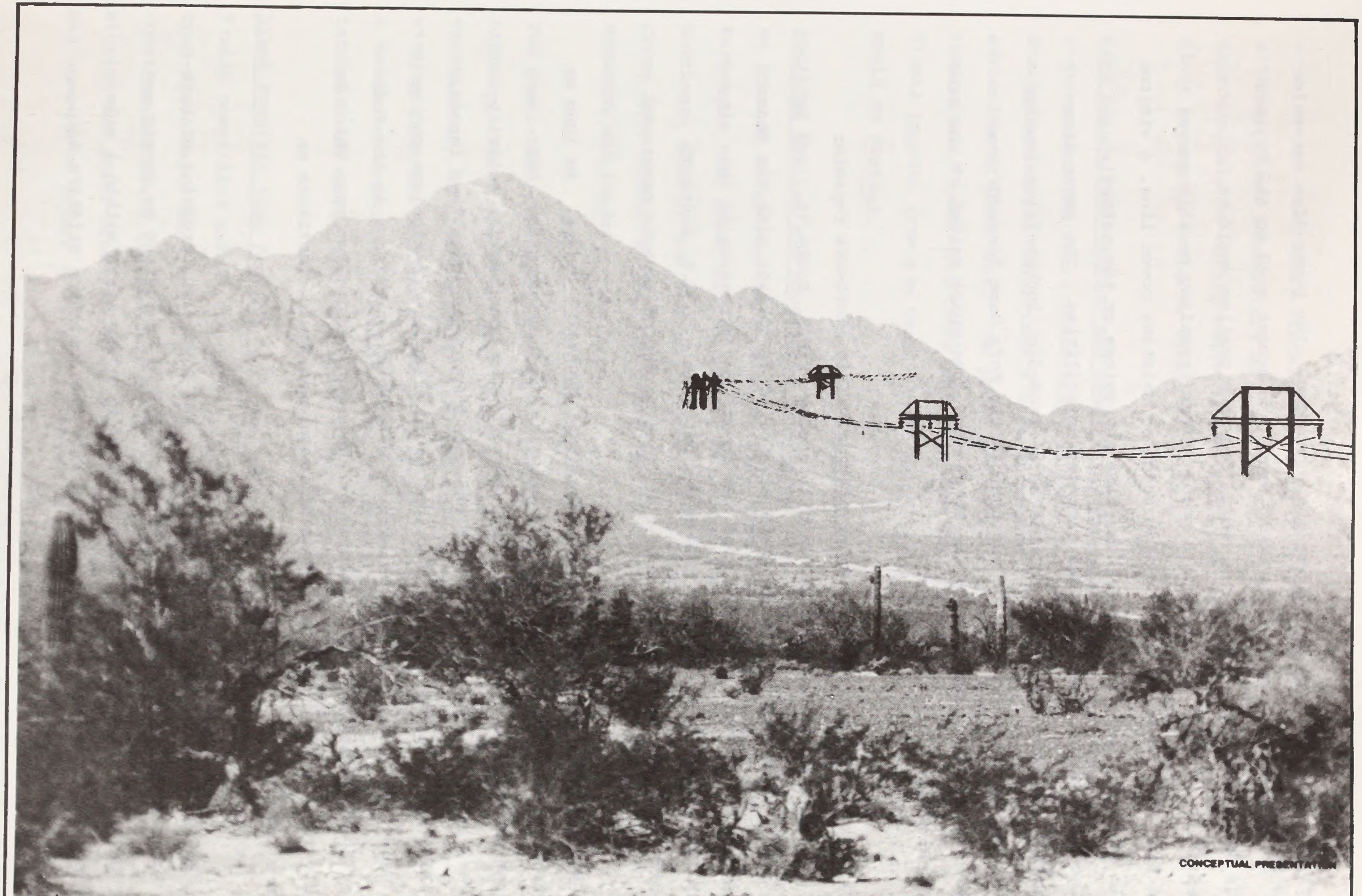


Figure 3.1.10.3-5 Power-line extension over Dome Rock Mountain to Ehrenberg Pump Station as seen from U.S. 95

Livingston Pump Station and power-line extension. The power-line extension for the Livingston Pump Station would cross the access road to the Crystal Hills Campground/Kofa Game Range, while the pump station would be immediately adjacent to the access road. After traveling on this gravel road from U.S. Route 95 and crossing under an existing power line, a visitor would not anticipate any further man-made intrusions on the natural environment, except for developed campground facilities. The power-line extension and pump station would thus be a discordant industrial intrusion on the recreation experience of visitors to the Kofa Game Range/Crystal Hills Campground, as well as on the scenic and open-space values of the area (approximately 12 square miles).

South Trigo Peaks microwave repeater station. This microwave repeater station falls in the background visibility zone of U.S. Route 95, and is not likely to be visible, unless painted a color discordant with the desert background. However, an access road and power-line extension to this site would likely result in scars. This might be visible to U.S. Route 95 motorists. Applicant's proposal is too vague to define impacts precisely.

New construction, Kofa Game Range to Eagletail Mountains bajada. As long as the new construction stays within the existing pipeline corridor, the adverse visual impact will be limited to short-term construction activity and resultant dust generation during the construction period. This impact, depending on the season of construction, could affect recreationists on the Kofa Game Range and backpackers seeking a wilderness experience in the Kofa or Eagletail mountains. Any widening of the existing pipeline scar which is visible from both the Kofa and Eagletail mountains would constitute an adverse impact.

Gila Pump Station and power-line extension. The power-line crossing of both U.S. Route 80 and the Gila River greenbelt would be intrusions on scenic and open-space values on an area already impacted by power lines within 1 mile or less. The Gila Pump Station, visible from the Arlington Wildlife Refuge, would be an additional visual industrial intrusion on an agricultural area, although sited immediately adjacent to the existing Gila Compressor Station. Approximately 16 square miles of the Arlington Wildlife Refuge and Gila River greenbelt would be visually impacted by proposed power lines.

Casa Grande Pump Station and power-line extension. The Casa Grande Pump Station would be sited immediately adjacent to the Casa Grande Compressor Station and would constitute a further industrial intrusion on a rural agricultural landscape. The power-line extension would traverse an agricultural area with other existing overhead power-line intrusions. Visual impacts from the Casa Grande Pump Station and power-line extension would be minimal.

Coolidge Station and power-line extension. The Coolidge Pump Station would be located on the southwest side of U.S. Routes 80/89 (the Pinal Pioneer Parkway). The power line tapped by the extension would parallel the northeast side of the highway, necessitating that the power-line extension cross this scenic highway approximately 2 miles northwest of the Tom Mix Monument and roadside rest area.

The power-line crossing would be visible from approximately 4 miles of highway. The power line would cut a 2-mile swath through the desert vegetation. Much of the power line and the pump station would not be visible from the designated scenic highway or monument/roadside rest area as a result of vegetative screening, but would nevertheless be a significant intrusion on scenic and open-space values in the immediate area.

Black Mountain Pump Station and power line. The Black Mountain Station and 7-mile power-line extension would be located in an area with scenic and open-space value and an area of visual sensitivity. The power-line construction would require removal of the desert vegetation. The pump station and power-line extension would have severe impacts on scenic quality and open-space values (within a 15-square-mile area the power line would be a dominant visual intrusion). The Black Mountain Pump Station would be viewed in the background visibility zone from several miles of Arizona 77, while motorists on U.S. Route 80/89 would view the pump station in the middleground distance for several miles.

Oracle Compressor Station abandonment

Abandonment and dismantling of this natural gas compressor station would remove an industrial intrusion on scenic and open-space values, thereby upgrading an approximately 10-square-mile area in which the compressor station is a dominant visual intrusion. The view from Arizona Highway 77, a designated scenic highway would be improved over an approximate 6-mile stretch (3 miles each direction of travel) by the removal of this compressor station which is now a dominant visual element.

Redington Pump Station and power-line extension. The Redington Pump Station site on Soza Mesa would be in the background visibility zone of the Galiuro Wilderness Area (10 to 12 miles away). The San Pedro River basin south of the San Manuel Copper Mine is a rural/natural landscape with few intrusions other than a power line, several roads, the existing pipeline corridor, and ranch buildings, fences, etc. The Redington Pump Station and power line would represent a visual industrial intrusion that would adversely impact the scenic quality, and open-space value of the San Pedro River basin. The power line would be a visually dominant element within a 16-square-mile area, while the pump station would be a visually dominant element in a 4-square-mile area.

Bowie Compressor Station

The abandonment and dismantlement of this natural gas compressor station would remove this visual intrusion on scenic and open-space values, thereby upgrading an approximate 10-square-mile area from which the compressor station is a dominant visual intrusion, especially from the highly scenic

Dos Cabezas Mountains. The view from both Interstate 10 for approximately 3 miles (1-1/2 miles in each direction), and U.S. 666 would be improved by the compressor station removal. This is especially true for U.S. 666, which in a southbound direction is axially lined up for approximately 6 miles with this obvious industrial intrusion at the base of the highly scenic Dos Cabezas Mountains.

Cochise Pump Station and power-line extension. The Cochise Pump Station lying within the foreground visibility zone of Interstate 10, would be an obvious industrial facility in a rural area, adversely affecting tourists' travel experience for approximately 2 miles. The route of the power-line extension from the Cochise Pump Station to the Sulphur Springs Valley substation would impact the scenic value of the bajada of the Dos Cabezas Mountains, and cross Interstate 10 to reach the Redfield substation. The power line would be a visually dominant element within a 28-square-mile area of the Dos Cabezas Mountains. The power-line crossing Interstate 10 would be visible from approximately 4 miles of highway.

New Mexico

Lordsburg Pump Station and power-line extension. The pump station would be sited adjacent to the Lordsburg Compressor Station just north of Interstate 10. The power line would extend for 6 miles to the north through an area of open-space value presently unencumbered by overhead intrusions. The power-line extension would constitute an adverse visual impact on approximately 24 square miles of open-space value while the visual impact of the pump station would be relatively insignificant.

Deming Pump Station. The Deming Pump Station would be sited in an agricultural area with proposed power-line extensions going through an area presently encumbered by other overhead utilities. The visual impacts of the pump station and new power lines would be relatively insignificant.

Anthony Pump Station and power-line tap. The Anthony Pump Station west of Interstate 10, would be located in the vicinity of an existing power-line substation east of Interstate 10. The power-line tap would be minimal in length but would cross I-10 and be visible to motorists from approximately 2 miles of the interstate highway. The visual impacts of the pump station and power-line tap would be relatively insignificant.

Pecos River Pump Station and power-line extension. The Pecos River Pump Station would be on the opposite bank of the Pecos River from the existing compressor station. The power-line extension would extend north for 32 miles through an extensive area of open space value unencumbered by overhead intrusions. A power line would be a visually dominant man-made intrusion on the flat brushlands and grasslands and would impair approximately 128 square miles of open-space value. The pump station also would be an intrusion on open-space values impacting approximately 4 square miles.

Texas

El Paso Pump Station and power-line extension. The El Paso Pump Station would be located within the foreground visibility zone (approximately 1.5 miles) of Hueco Tanks State Park. As the park is presently surrounded by open-space lands, the siting of this industrial facility close to the park would significantly degrade the visual environment of the park and the quality of the recreational experience for park visitors. Likewise, the power-line extension would traverse an open-space area presently unencumbered by overhead utilities. For 1 mile, the power-line extension would be within the foreground visibility zone of the park, and would constitute a significant intrusion into the park's visual environment. In addition to the park area, the power line would visually dominate approximately 24 miles of open-space land presently free of overhead utilities (Figure 3.1.10.3-6).

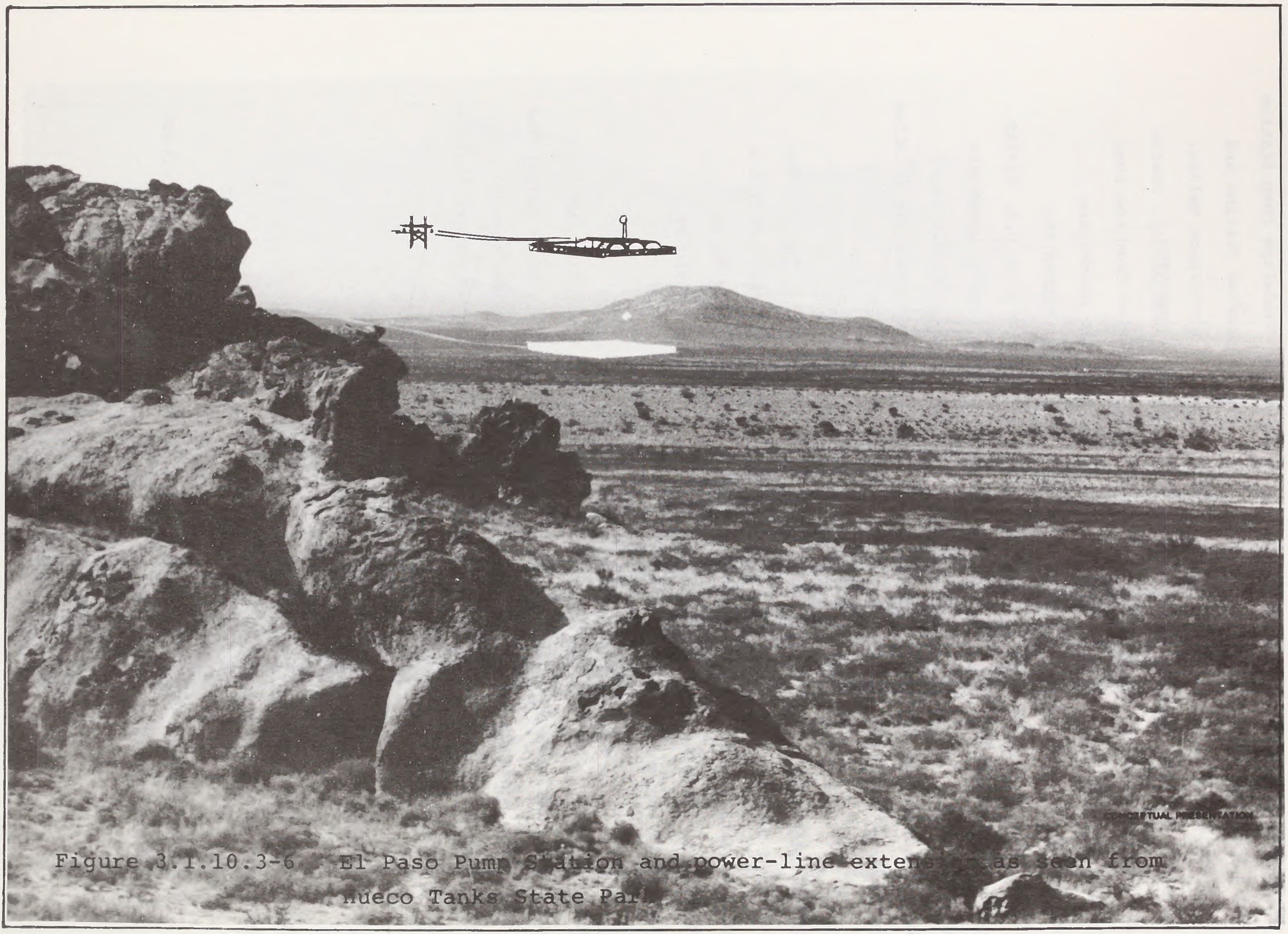


Figure 3.1.10.3-6 El Paso Pump Station and power-line extension as seen from Hueco Tanks State Park

Guadalupe Pump Station and power-line extension. The Guadalupe Pump Station would be sited adjacent to the existing Guadalupe Compressor Station and thus would have a minimal visual impact on scenic and open-space values. However, the site is within the foreground visibility zone of U.S. Routes 62/180, and represents a further deterioration of the view from the road affecting approximately 2 miles of highway. The 16-mile power-line extension to serve the Guadalupe Pump Station is routed within the foreground to middleground visibility zone (.25 to 2 miles) of U.S. 62/180 across the visually interesting salt flats. There outstanding panoramic views from U.S. 62/180 of the Guadalupe Mountains across the salt flats would be visually marred by the power-line intrusion (approximately 12 miles of highway) (Figure 3.1.10.3-7).

New Pipeline construction, New Mexico state line to Midland, Texas. The pipeline construction would be largely through areas with relatively low scenic quality and visual sensitivity, lacking in open-space value. Therefore, the visual impact of the proposed construction would be relatively insignificant.

The construction between the New Mexico state line to Texas 115, however, would traverse an area with open-space value for approximately 12 miles, and the surface scars of pipeline construction and maintenance roads would constitute an encroachment on this open-space value (affecting approximately 12 square miles of area).

3.1.11 Noise

The prediction of noise levels at receptor points in the vicinity of a construction site requires consideration of three factors:

1. Identification and location of construction equipment and operations which are significant noise sources.

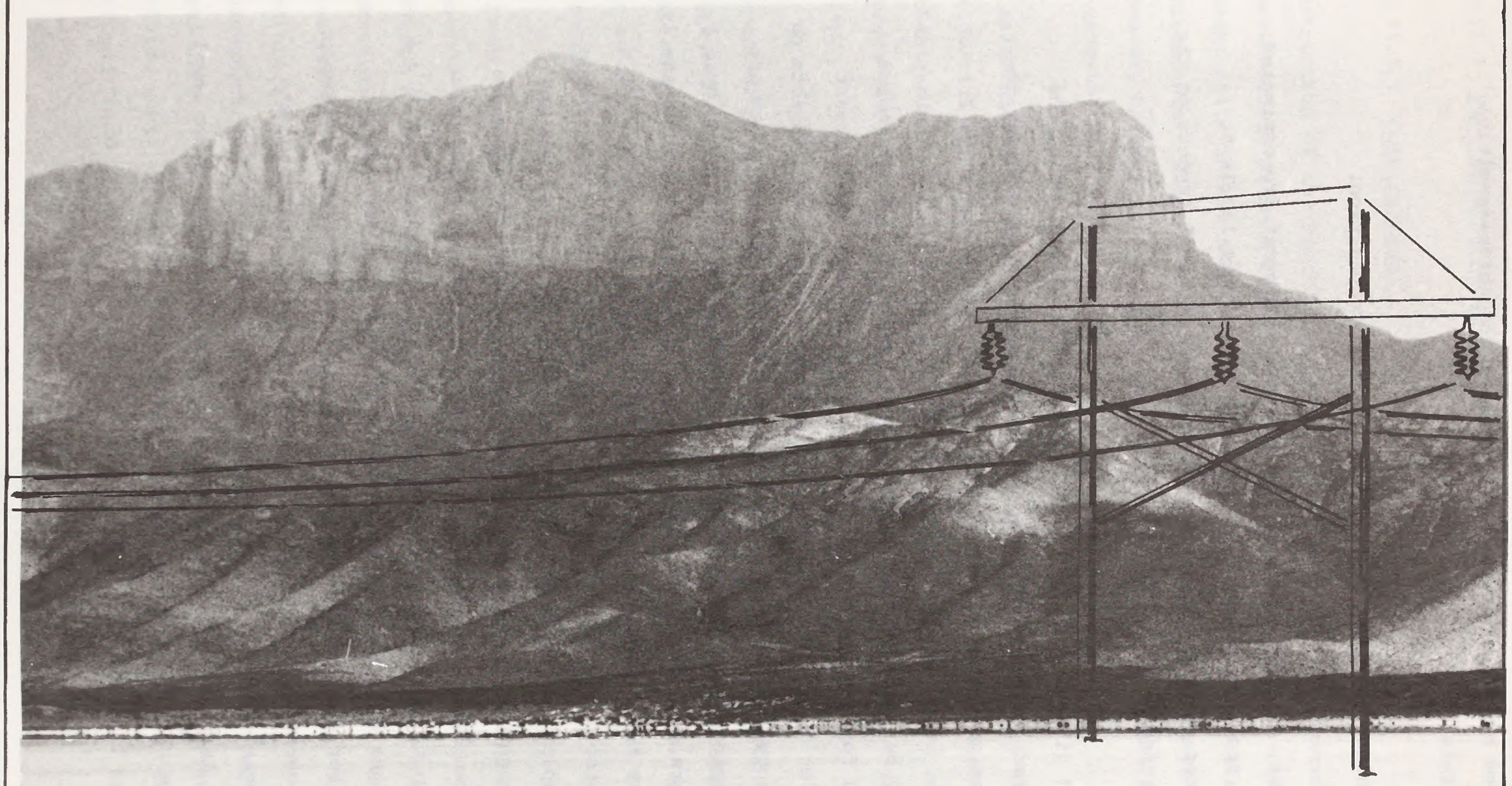


Figure 3.1.10.3-7 Guadalupe Mountains National Park as seen from U.S. 62/180 with Guadalupe Pump Station power-line extension

2. Distances between construction equipment and noise-sensitive receptor points.

3. Intervening obstacles or barriers to sound propagation.

The procedure is: (1) Noise levels from expected equipment are estimated; and (2) a noise propagation model is employed to estimate levels at sensitive receptor points, taking into account the physical aspects of the intervening distance.

Appendix A3.1.11 gives a description of noise levels of equipment, the computer model for noise propagation, and methodology for estimating the increase in noise over the ambient level.

Noise impact may be judged with reference to two criteria. First, noise levels projected for the planned facility must comply with the relevant Federal, state, or local standards or regulations. (Since noise impacts on workers would be typical of those for major construction projects and are well known to state regulators, the impact on workers is not treated here.) The second measure of impact recognized by noise analysts is the increase in noise level above the existing ambient, a result of the introduction of a new source of noise. The change in noise level due to a new noise source can create an impact on people; the degree of impact is hard to assess because of the highly subjective character of individuals' reactions to changes in noise. Empirical studies have shown that persons in an urban environment begin to distinguish changes in noise level of approximately 5 dBA. Thus, changes in noise levels lower than 5dBA may be considered insignificant. For changes above 5 dBA, it is difficult to quantify impact beyond the obvious: the greater the noise level change, the greater the impact. A judgment commonly used in community noise impact analyses associates noise increases of 5 to 15 dBA with "some impact." Noise level increases of more than 15 dBA are generally considered severe.

3.1.11.1 Port of Long Beach and terminal area

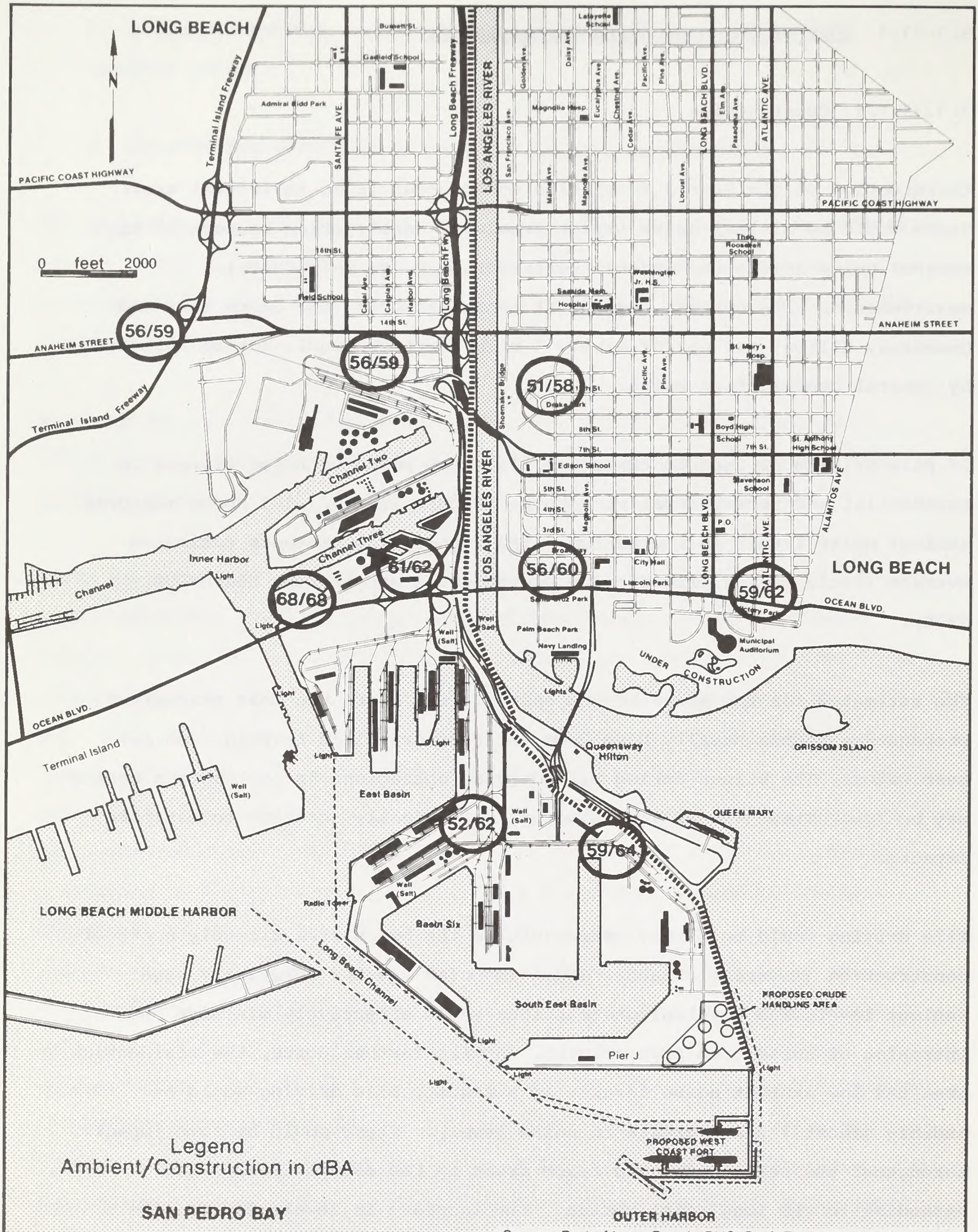
3.1.11.1.1 Construction

Construction of the Pier J facilities would occur in an industrial area. There would be minimal noise impact from most construction because of high ambient noise levels and general tolerance of noise in industrial environments. The nearest commercial establishments (the Queen Mary and Queensway Hilton) are approximately 1 mile north and would not be affected by general construction noise.

If pile driving is used to compact soil, there would be noise impacts on residential and recreational receptors. Figure 3.1.11.1.1-1 shows measured ambient noise levels in the harbor. The figure also presents estimated average levels during pile-driving operations (Port of Long Beach/PUC, 1976).

The estimates for the areas to the east of Pier J are the most tentative; propagation models usually have been verified over land terrain, and not over water. The values during pile-driving operations in the eastern sector may be low. These values are, however, sufficiently accurate to estimate impacts.

Pile driving would be barely noticeable in the beach area directly north of construction (increase of about 4 dBA in noise level); relatively high ambient levels and physical obstructions would effectively minimize the intrusion of noise from pile driving. A mile farther north, the residential area has low ambient noise levels; as a result, pile driving would be audible (about 7 dBA increase in noise level). There would be some impact throughout the residential and beach areas to the east of Pier J and extending to the Long Beach Marina. The increase in levels during pile driving would range from 4 to 8 dBA with the maximum in the central section (around Third Street and Obispo Avenue). Pile driving would be audible



Source: Port of Long Beach/PUC, Draft Environmental Statement

Figure 3.1.11.1.1-1 Daytime L_{50} ambient noise levels and estimated levels during pile driving

(about a 5 dBA increase) in the area around the Queen Mary, and around the Queensway Hilton.

Dominguez Hills terminal construction

Appendix A3.1.11.1.1 contains a worst case scenario for construction equipment activity and environmental conditions. From this, noise levels at various distances are estimated.

This site is within an industrial area, and is 2,500 feet west and 3,500 feet north of residential areas. Computations from data in the Appendices (Table A3.1.11-2 and Figure A3.1.11.1.1-1) indicate that there would be at most a 3 dBA increase in noise levels in the residential area to the west of the construction site and none in the area to the south. Since the intervening industrial buildings were ignored in the computation, construction noise should go unnoticed in either residential area.

A main-line oil pump station would be included in construction. See Section 3.1.11.2.1 for additional discussion.

3.1.11.1.2 Operation

Pump stations. The proposed main-line pump station at the Dominguez Hills terminal would contain the only significant noise sources, which are the electric-motor pump units and transformers. The applicant is committed to designing the pump stations in such a way that the maximum OSHA noise level (85dBA) would not be exceeded.

Appendix 3.1.11.1.2 describes the method used in assessing expected pump noise. Limited data required using an upper limit estimate for noise levels.

Dominguez Hills terminal. The nighttime noise level in the residential area to the west of the Dominguez Hills terminal site should increase less than 3 dBA. There would be no noise impact on residential areas under any conditions during pumping operations at this site.

3.1.11.2 Pipeline route significant area

3.1.11.2.1 Conversion/construction

Construction. Appendix A3.1.11.2.1 describes construction procedures, noise factors, noise modeling assumptions, and noise propagation data. From the spread of equipment, the rate of progress in pipe laying, and the distance of a receptor from the pipeline route, it can be estimated how many days a given sensitive receptor would be exposed to noise at or above a certain level. Then, through a knowledge of the ambient level and use of the methodology in Appendix 3.1.11, the degree of impact can be estimated.

Pipeline construction. The duration of noise impact at a specific receptor depends on type of pipe-laying spread, ambient noise level, and distance of the receptor from construction. Duration and severity of impact is high when the construction is proximate and the ambient noise level is low. If either factor is missing, the impact diminishes considerably. Duration of impacts are 2 to 3 times greater when an urban spread is involved (construction activity in a span of about 300 feet and progressing at about that distance per day), rather than a suburban spread (construction spanning about 1,500 feet and progressing at up to 1 mile per day [Appendix Figure A3.1.11.2.1-1]).

Table 3.1.11.2.1-1 lists the potential receptors, identified in Table 2.1.11.2-1, that were found to be susceptible of noise impacts. Sixty-five sensitive receptors (schools, parks, residences, etc.) were identified. Severe noise impacts (at least a 15 dBA increase in daytime noise levels) would be experienced by 33 receptors. Some impact (5 to 15 dBA increase) would be experienced by 32 other receptors. Severe impacts would last no more than five days for all but one of the 32 identified receptors. At residences, approximately 0.6 mile southeast of the Whittier Narrows Wildlife Sanctuary, severe noise impact would last about 8 days. If a suburban spread were to be used in this section, the duration of severe impact would be about halved, and the duration of all impact would drop from about 25 days to about 8 days. The average duration of severe impact at the 33 identified receptors would be about 2.5 days; the total duration of impact would average about 7.5 days. The 32 other identitified receptors would experience some noise impacts on 11 or less days; the average duration would be about 3.5 days.

Table 3.1.11.2.1-1

Sensitive Receptors and Identified Noise Impacts from Pipeline Construction

SENSITIVE RECEPTOR	Ref. Map[a]	Approx. Daytime Median Noise Level at Sensitive Receptor (dBA)	Estimated Days of Impact	
			Some Impact[b]	Severe Impact[c]
Palm Beach Park	A-2	60	1	
Residences (700)[d]	A-4	60	2.5	
Residences (800)	A-5	60	1	
Residences (300)	A-5	75	.5	
Country club	A-6	55	3	
Residences	A-7	60	5	
Residences	A-8	60	5	
Residences	A-9	65	3.5	
Dominguez High School	A-10	60	1	
Residences	A-10	60	5	1
Golf course	A-10	60	5.5	2
Residences	A-11	60	5	1
Residences	A-12	55	8	2
Los Padrinos Juvenile Hall	A-12	55	5	
Residences	A-13	55	8	
John A. Ford Park	A-14	55	8.5	3
Rio Hondo Country Club	A-14	55	8.5	3
Residences	A-14	55	8	2.5
Residences	A-15	50	15	5
Park	A-15	60	4.5	
Residences	A-16	55	8	1
St. Vincent's School (& Seminary)	A-17	50	14	4
Residences	A-17	50	14	4

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[a] A and B area maps in Appendix 2A.11 in Vol. 6 of Williams Brothers Environmental Assessment, March, 1976. T and no-letter maps refer to applicant submittal designated "Job 2276," dated 7/27/76.

[b] At least 5 dBA noise level above ambient.

[c] At least 15 dBA noise level above ambient.

[d] Where more than one set of residences are listed in Table 2.1.11.2-1 as being on one map, the residences identified as impacted are listed with the distances from construction.

Table 3.1.11.2.1-1 (Continued)

Sensitive Receptors and Identified Noise Impacts from Pipeline Construction

SENSITIVE RECEPTOR	Ref. Map[a]	Approx. Daytime Median Noise Level at Sensitive Receptor (dBA)	Estimated Days of Impact: Some Impact[b]	Estimated Days of Impact: Severe Impact[c]
Residences	A-18	55	8	2.5
Rio Hondo Park	A-18	55	8	2.5
Park-recreation area	A-19	50	15	5
Residences	A-19	50	15	5
Pio Pico School	A-19	50	11	
Residences	A-20	45	25	8.5
Wildlife sanctuary and park	A-21	50	6	
Equestrian area	A-21	60	4.5	
California Country Club	A-22	75	.5	
Residences	A-22	65	3	
Residences	A-23	60	5	
Residences	A-24	60	4.5	
Latin American Bible Institute	A-24	60	2.5	
Residences	A-26	60-69	1	
Residences	A-30	60	4	
Walnut School	A-31	55	7.5	
-- End of urban pipe-laying spread; start of suburban spread --				
Residences	9	45	4	
California Institute for Men	10	45	3.5	
Hawthorne Christian School	12	55	2.5	
Residences	12	45	5	2.5
Fontana Bird Park	B-5	45	4.5	
Crestmore school	B-5	50	2.5	
Park	B-5	50	3.5	2
Residences	B-5	50	3.5	2
Union Academy	B-7	50	3	1
Hospital (500)	B-7	50	3	1
Loma Linda University	B-7	50	3	1
Community Hospital	B-7	50	2	
Bryn Mawr	B-7	45	5	2.5
Residences	B-7	50	3.5	2
Creative Educational Center	B-7	55	2.5	0.5

Table 3.1.11.2.1-1 (Continued)

Sensitive Receptors and Identified Noise Impacts from Pipeline Construction

SENSITIVE RECEPTOR	Ref. Map[a]	Approx. Daytime Median Noise Level at Sensitive Receptor (dBA)	Estimated Days of Impact	
			Some Impact[b]	Severe Impact[c]
Hemmerling School	B-10	50	2.5	
High School	B-10	50	3	1
St. Boniface	B-10	50	2.5	
Residences	B-10	50	3.5	2
Repplier Park	B-10	50	3.5	2
Residences, School, (Desert Center, CA)	B-23	40	7.5	2.5
Residences (Blythe, CA)	44	40	7.5	2.5
20 to 30 Residences, (Jal, NM)	T-1	40	7.5	3
Country club	T-13	50	2.5	
Residences (Midland, TX)		50	3.5	1.5

Pump stations

Construction. The noise levels generated during construction of pump stations and pipeline would be similar. Noise levels within 1,500 feet of construction activity would be noticed in an environment with typical urban levels of ambient noise (about 60 dBA). The area wherein impacts may occur would be larger in locations with very low ambient noise levels. The duration of the noise would be longer, however, than for pipeline construction because the source is fixed. The overall construction period for a station has been estimated to be approximately 5 months, with significant noise emissions lasting for a somewhat shorter period.

Of the 18 main-line pump stations, only 3 have been identified as being close enough to noise sensitive receptors to have any potential for creating a noise impact. These stations and noise sensitive receptors are listed in Table 3.1.11.2.1-2.

Table 3.1.11.2.1-2

Pump Stations Having a Potential for Impacting Noise Sensitive Receptors

STATION NAME	State	Miles From Pier J	Description of Noise Sensitive Receptors	Distance of Noise Sensitive Receptor From Station (feet)
Redlands[a]	California	86	Community hospital, scattered houses	3,000
Desert Center[b]	California	198	School and houses west of station	5,500
Ehrenberg[c]	Arizona	258	Roadside rest area	1,500

[a] Map 1.1.1-2, Attachment 1.

[b] Map 1.1.1-4, Attachment 1.

[c] Map 1.1.1-5, Attachment 1.

Construction-noise levels at these receptors are expected to be approximately 55 dBA or less. Since these receptors are in areas with few, if any local noise sources, existing daytime ambient noise levels are estimated to be in the range of 40 to 45 dBA. Thus, construction noise would be audible (noise increments would range from 3 to 19 dBA). Noise levels at the community hospital in Redlands would increase about 10 dBA.

Pipeline conversion

It is anticipated that the scale of activity and consequent noise level associated with pipeline conversion would be equal to or less than that for new pipeline construction. There are, however, no significant noise sensitive receptors in the vicinity of pipeline conversion activities; therefore, noise impacts would be negligible. Removal of one gas pipeline would result in greater noise emissions from gas pipeline compressor stations owing to the need to overcome additional friction in the remaining lines. No dwellings are sufficiently close to the compressor stations, however, to give rise to annoyance from the increased levels.

3.1.11.2.2 Operation

Sources

During the operational phase of the project, project noise sources in the pipeline area would be those associated with: (1) continuous 24-hour operation of the main-line pump stations; and (2) periodic pipeline inspection and pump-station maintenance.

Pump stations

Noise from pump-station operation would be perceived as being slightly quieter and steadier than noise from construction. However, since the operation of a pump station is on a 24-hour per day basis, station operation would be clearly heard at those receptors at distances of 2,000 to 3,000 feet and even greater when daily background noise levels are lowest (generally at night and early morning) and during certain atmospheric conditions (temperature inversions and/or receptor being downwind of source). The estimated increases in noise levels at the receptors in Table 3.1.11.2.1-2 during quiet conditions (38 to 45 dBA) are:

1. Redlands: 4 to 10 dBA
2. Desert Center: 1 to 10 dBA
3. Ehrenberg: 10 to 17 dBA

There may be some degree of annoyance and complaints as a result of the change in noise levels at some of these receptors.

Inspection and maintenance operations

The pipeline route and valves would be inspected weekly or biweekly. The primary noise sources associated with inspection are the transportation vehicles used by the inspection personnel. In remote, rural portions of the pipeline, inspections would be performed by low-flying aircraft (500 to 1,000 feet aboveground). In more settled areas, inspections would be performed by automobiles or light-duty trucks.

Maintenance operations would be performed principally at the pump station sites. Noise sources might occasionally involve welding equipment and cranes.

Small aircraft. Small aircraft (not expressly designed for low noise emissions) could be expected to create noise levels corresponding to 75 to 80 dBA at flyover heights of 500 to 1,000 feet, respectively. A small noise impact would be experienced by a few persons on occasion in rural areas.

Trucks. Inspection noise levels from light-duty trucks would be on the order of 50 dBA at 50 to 100 feet. The impacts would be very small and infrequent.

Since maintenance operations would be primarily at operating pump stations, it is estimated that there would be a maximum increment of 3 dBA in overall noise levels from typical maintenance operations near a pump station.

3.1.11.3 Midland terminal area

3.1.11.3.1 Construction

Sources and levels. Construction equipment used in building the Midland terminal should be similar to that used on the Long Beach terminal. The construction schedule in Figure If-1 of the Williams Brothers Environmental Assessment suggests that noise levels would be slightly lower and duration would be slightly shorter in the vicinity of construction of the Midland terminal than at Long Beach.

Impacts. The Midland terminal site is located approximately 2,000 feet or more from residences in Midland. These residences are near local noise sources such as major highways. Because of existing noise levels at these receptors and their distances from the terminal site, the increase in noise levels over ambient noise levels is not expected to be more than 5 dBA. Therefore, no significant noise impact is expected from the construction of the Midland terminal.

3.1.11.3.2 Operation

Because there is no pump station in this portion of the project, there are no significant noise sources or noise impacts.

3.1.12 Land uses

3.1.12.1 Construction

The impact of the project construction and operation upon land use results from the location of the proposed route and ancillary improvements on the existing, planned or anticipated land uses. In this evaluation, the land use is classified under the following categories:

1. Agricultural/cultivated lands.

2. Open space/grazing lands; i.e., otherwise undeveloped lands.

3. Developed lands including industrial, residential, commercial, and other heavy and light urban uses.

4. Transportation and utility rights-of-way, including both publicly and privately owned property used for public purposes; i.e., road, railroad, power-line or other pipeline rights-of-way, stream beds, riverbeds, or flood control channels.

Ownership status is also shown for the four land use classifications in Tables 3.1.12.1-1 and 3.1.12.1-4. Much of the open land is owned by the United States or the individual states; state lands are often leased to individuals or corporations.

California

For the proposed breakwater in Long Beach Harbor, the Pebble Beach Quarry on Santa Catalina Island will be enlarged in both operation and acreage disturbed to supply 2.5 million tons of rock. The use of the quarry will involve blasting, bulldozing, and loading of barges that will be visible and disturbing to recreationalists on the island including offshore fishermen.

Approximately 251.2 miles of the pipeline route traverses three counties in California (Los Angeles County, 47.7 miles; San Bernardino County, 40.5 miles; and Riverside County, 163 miles). A summary of use patterns traversed by the pipeline is given in Table 3.1.12.1-1. Existing right-of-way would be utilized or paralleled wherever possible. This includes the use of power-line and improved channel rights-of-way.

Table 3.1.12.1-1

Land Uses Impacted by the Proposed Pipeline in California

USE	Los Angeles	San Bernardino	Riverside[a]	Total Miles
	Counties			
Agricultural/ cultivated	0.0	15.6	17.2	32.8
Open space/ grazing	6.2	3.5	16.2	25.9
Developed	0.0	3.1	0.0	3.1
Rights-of-way	41.5	18.3	129.6	189.9
Total Miles	47.7	40.5	163.0	251.2

[a] Of these distances in Riverside County, 121.8 miles are existing pipeline belonging to the Southern California Gas Company.

From the Port of Long Beach along the Los Angeles River channel and up San Jose Creek, the pipeline route follows the flood control channel rights-of-way. Property within this corridor is public, and buried line would not affect the hiking, equestrian, biking and other recreation proposed for long-term land uses in the channel corridor. The adjacent urban land uses will be impacted by proposed construction activities (noise, dust, traffic disruptions, etc.), but these are considered short-term in nature.

The terminal site proposed for Dominguez Hills appears to have fewer potential adverse environmental effects because the site is located within an industrial area buffered by other activities related to storage and industry, and the proposed pipeline routing to the Dominguez Hills terminal site follows the westerly side of the flood control channel, avoiding potential disruptions to recreational land use proposals along the east side of the channel.

Approximately 41.5 miles of rights-of-way land in Los Angeles County comprise the flood control channel. The 6 miles of open space represents the flood control basin which also has recreation and oil production. In San Bernardino County the rights-of-way for 18.3 miles are largely electric transmission line ROWs. Of the total 163 miles of pipeline in Riverside County, approximately 122 miles is existing pipeline traversing developed and open-space uses. It is proposed that this be converted from natural gas to crude oil service. Combining the 67.6 miles of other rights-of-way with the 121.8 miles of existing pipeline, the resulting 189.4 miles, or 75.4 percent of the pipeline route in California, is expected to have minimal impact on the existing or planned land use. The remaining 25 percent, or 64.2 miles, of proposed pipeline traverses agricultural land for 13 percent of the total distance and developed land for only 3.1 miles, or less than 2 percent, of the distance, with the remainder of the proposed pipeline traversing open-space lands.

Construction through the lands with existing agricultural/cultivated uses would result in a short-term impact involving the loss any crops along the construction-corridor during the construction period. Once construction is completed, the pipeline route would return to the original use although overall productivity would in most cases be reduced for a few years, depending on the trenching method and the condition of the soil.

Table 3.1.12.1-2 presents the acreages per use for working and permanent right-of-way. Working right-of-way is defined as that area which is expected to be directly affected by construction. From Long Beach to Dominguez Hills, working rights-of-way will average 40 feet; from Dominguez Hills to the existing line near Beaumont, 50 feet. The 32.7-mile segment in eastern California to the Colorado River would have a nominal width of 85 feet for working right-of-way.

Table 3.1.12.1-2

Acres of Land Uses Impacted For Rights-of-Way in California

COUNTIES	Agricultural/ Cultivated	Open Space/ Grazing	Developed	Public	Total Acres
Los Angeles					
Permanent[a]	0.0	37.6	0.0	251.5	289.1
Working[b]	0.0	63.2	0.0	423.3	486.5
San Bernardino					
Permanent	94.5	21.2	18.8	110.9	245.4
Working	159.1	35.7	31.6	186.7	415.1
Riverside					
Permanent	104.2	77.8	0.0	622.1	804.1
Working	175.4	85.4[c]	0.0	1,321.9	1,582.7
Total Acres					
Permanent	198.7	136.6	18.8	984.5	1,338.6
Working	334.5	184.3	31.6	1,931.9	2,482.3

[a] Permanent right-of-way: 40 feet.

[b] Working right-of-way: Averages 40 feet from 0 to 11.3 miles inland. Averages 50 feet from 11.3 to 96.7 miles across the proposed route. Approximate minimal distance of 85 feet thereafter.

[c] Includes the acreage for the existing pipeline segment; 16.9 percent of the total areas identified are proposed to have new construction activity the remainder would be unchanged from present status.

A permanent right-of-way of 40 feet would be utilized by the pipeline. Of the 782.4 acres of permanent right-of-way acres in Riverside County, 584.6 acres represent the existing pipeline of the Southern California Gas Company. The acreage needed for pump station sites is expected to average 10 acres per site. Of the 40 acres needed for pump stations in California, 20 acres are currently in an open-space land use classification (Indio and Desert Center pump stations), 10 acres are in developed land (Dominguez Hills), and 10 acres in agricultural lands (Redlands). The imposition of the pump stations, which may be classified as an industrial use may have a long-term impact on future agricultural, recreation or open-space planning efforts adjacent or in close proximity to the sites.

Construction through open-space or open-grazing lands is not expected to cause significant impacts, as both existing vegetation and rural development is sparse. Short-term impact is expected to result from the loss of any grazing during the construction period, and several years thereafter. Section 3.1.7.2.1 discusses the vegetative impacts including the number of AUMs that would be removed from productivity due to the proposed project.

Transmission lines supplying pump stations with electric power would require the use of poles and overhead wires, resulting in unavoidable local, but long-term, aesthetic impacts and would possibly induce further development into open space reserves which currently do not have service.

The initial portion of the pipeline route in Los Angeles County would traverse an area of intense urbanization. However, use of the existing Los Angeles River flood control channel and the Rio Hondo channel would minimize the anticipated impacts of construction on the urban areas.

The level of impact on urban areas would be minor when compared to the overall availability of land in the area and the potential use of the route for secondary uses such as open space, greenbelt areas, recreation buffers, or utility corridors. Such land uses are integral portions of these developed areas. The overall level of impact also would be reduced because the proposed route traverses those localities where the existing urban development is sparser. Likewise, the future demand for open space greenbelt buffers in and around the area would increase as the development of this area continues.

Additional adverse impacts upon these urban areas can be expected as a direct result of the construction phase. These impacts would result from localized traffic congestion caused by construction, supply and personnel vehicle movements, and by construction noise.

Table 3.1.12.1-3 lists the public, state, and Indian reservation lands crossed by the proposed pipeline route. The pipeline route through these areas should not result in any temporary loss of utilization, since the existing pipeline now traverses these areas. The level of impact is expected to be minor and should not interfere with the utilization of these public lands for their specified purposes.

Table 3.1.12.1-3

Public,[a] State, and Indian Reservation Lands Traversed by the Proposed Route in California

PARCEL	County	Mileage
Morongo Indian Reservation	Riverside	4.0
Agua Caliente Indian Reservation	Riverside	2.0
State of California	Riverside	2.0
Bureau of Land Management	Riverside	74.6

[a] Public lands listed in this table do not include privately owned property used for public purposes.

It is estimated that approximately 23.6 miles of the proposed route would adjoin or abut existing rights-of-way in addition to the 35 miles of the proposed route within the Los Angeles River-Rio Hondo flood control channels (excluding the Whittier Narrows Flood Control Basin). By adding these figures to the 122 miles of existing pipelines to be used, it can be seen that approximately 75 percent of the proposed route in California is within or adjoins existing transportation corridors.

The planned land use for California is discussed in Section 2.1.13.2. Some agricultural land, specifically in San Bernardino County, is planned for industrialization and other developed uses.

Arizona

The impact of construction activities on land use along the pipeline route east of Ehrenberg would be temporary and of short duration. Of the 352 miles of pipeline in Arizona, 40 miles would be new construction. The rest of the land would be unaffected except for installation of transmission lines and pump stations.

New pipeline construction would occur in the Kofa Game Range on existing pipeline right-of-way, although all new construction will be within the existing right-of-way. No new construction is proposed on the existing pipeline through the Coronado National Forest. Therefore, no additional land use impacts will be imposed on these two areas beyond what has already occurred; namely, the existing right-of-way. Reserved public lands traversed by the proposed route east of California are presented in Table 3.1.12.1-4.

The 34.2 miles of new pipeline construction east of the Livingston Pump Station crosses land classified as open space or open grazing land. Note Section 3.1.7.2.1 for a discussion of the AUMs that would be lost to livestock grazing if the project is implemented. Temporary land requirements during construction would include additional right-of-way for marshalling and storage yards for materials and equipment. The construction right-of-way width would be approximately 85 feet along the new section to be constructed; El Paso Natural Gas Company has permanent easements of 40 feet, and no new permanent rights-of-way would be required.

The Bowie and Oracle natural gas compressor stations would be removed. This would result in beneficial impacts by removing an industrial intrusion in an area of open-space value. Sections 3.1.7.2.1 and 3.1.10.2 also discuss the abandonment of these stations.

Table 3.1.12.1-4

Reserved Public Lands[a] Traversed by the Proposed Route East of California

PARCEL	Location	Mileage
Kofa Game Range	Yuma County, Arizona	24.3
Coronado National Forest	Cochise County, Arizona	2.0
Fort Bliss Military Reservation	El Paso, Texas	7.0

[a] Public lands listed in this table do not include privately owned property used for public purposes, areas administered by the Bureau of Land Management or state lands.

New Mexico

A short new pipeline segment of the final section to Midland, Texas, is proposed to begin at Jal, 10 miles from the New Mexico-Texas border. Construction activities would be temporary and no long-range effects on land use are expected except for a 10-mile-long, permanent right-of-way totalling 48 acres. Present classification of this land is open space or open grazing, and no changes in future uses are planned. Note Section 3.1.7.2.1 for a discussion of the AUMs lost on this proposed new segment. Temporary land requirements are discussed in the preceding section for California and apply to construction and conversion activities in New Mexico.

Texas

The remaining section of new pipeline installed between Jal, New Mexico, and Midland, Texas, crosses open space for 63.1 miles in Texas. Land requirements for marshalling and storage yards for materials and equipment would be temporary. Right-of-way width for short duration use would be 85 feet along new sections constructed. This permanent right-of-way of 63.1 miles would encompass 382 acres. In view of the transitory nature of construction activity, no long-term adverse effects on land use are expected in the areas where pipeline construction would occur. Installation of transmission lines would have local aesthetic impacts and might induce urbanization or other intensification of land use in areas which do not presently have electrical service. Land requirements and conversion activities discussed for the previous states are applicable to Texas. The 50-acre terminal site in Midland involves the greatest impact of construction on land use. Present use is classified as cultivated land but the land is zoned "industrial," and there are neighboring commercial and industrial uses. Note Section 3.1.7.2.1 for a discussion of the AUMs of productivity lost to livestock grazing along the 63 miles of new construction.

3.1.12.2 Operation and maintenance

The land-use impacts associated with the operation of the pipeline system and accompanying pump station would result from the maintenance of the right-of-way, repairs to the pipeline, aesthetic infringement, and pump station operation.

After completion of the construction phase, the right-of-way would be restored and maintained in a cleared condition, except for agricultural areas where the right-of-way could be used for crops. Operation and maintenance of the system would remove right-of-way lands from their existing land use potential for the life of the project, with the resultant impact being minor but long-term. However, at the end of the project the right-of-way could be totally reclaimed and returned to its original land use. The presence of the route on road, utility and flood control rights-of-way and water areas would not interfere with the uses of these areas.

In non-agricultural areas the right-of-way would be maintained free from large shrubs and trees which would interfere with pipeline inspection and maintenance. In agricultural areas the right-of-way would return to agricultural production during the next growing season. Periodic aerial inspections of the right-of-way are to be made to identify trouble spots such as erosion and unauthorized construction activities, and to prevent detrimental encroachment on the right-of-way.

Adverse long-term impacts on land use would occur from location of pump stations in agricultural areas and in open-space areas with recreational or scenic values. Pump stations are industrial in character and hence may be regarded as incompatible intrusions on agricultural and open-space areas.

In California, the Redlands Pump Station is located in a prime agricultural area of valuable citrus groves, and would preempt 10 acres of this valuable agricultural land. The Indio Pump Station is located in an open space area adjacent to and visible from Interstate 10. The siting of the Desert Center Pump Station next to an existing natural gas compressor station minimizes adverse land use impacts.

In Arizona, the Ehrenberg Pump Station is located in an open-space area immediately adjacent to an Interstate highway roadside rest area, and the Livingston Pump Station is located in an open-space area immediately adjacent to both the Kofa Game Range and the access road to the Livingston Hills Campground. Location of the Gila and Casa Grande pump stations adjacent to existing natural gas compressor stations minimizes adverse land use impacts. Coolidge, Black Mountain and Redington pump stations are industrial intrusions located in open-space areas, while the Cochise Pump

Station is located in an agricultural/open-space area. Abandonment of the Oracle and Bowie natural gas compressor stations would have a beneficial land-use impact by removing these incompatible industrial facilities from open-space areas.

In New Mexico, Lordsburg and Deming pump stations would have no adverse land-use impacts as they are adjacent to the developed areas, but the Anthony Pump Station would constitute an industrial intrusion on agricultural croplands. The Pecos Pump Station location represents an industrial intrusion on an open-space area.

In Texas, the El Paso Pump Station would be located adjacent to Hueco Tanks State Park and hence would constitute an adverse land-use impact. Location of the Guadalupe Pump Station next to the existing natural gas compressor station would be considered a compatible land use, except that expansion of an industrial complex next to Guadalupe National Park is not desirable.

During the operational phase of the project, it might become necessary to repair the pipeline. These procedures would result in a localized, short-term impact similar to, but less than, that generated by the construction of the proposed project.

The Midland terminal site is in an area where other tank farms are already established. Therefore, the operation and maintenance of the Midland terminal would not have an adverse effect on surrounding land use.

Another consideration of land-use impacts from the operation and maintenance of the project involves the overall safety aspect of a pipeline as a mode of transportation. There are approximately 1 million miles of pipeline throughout the United States carrying a variety of products. On a comparative basis, pipelines are the safest mode for transporting products. Statistically, for the period 1963 to 1968, the deaths per billion ton-miles were 10.9 in Federally regulated trucking, 2.5 for railroads, an estimated

0.31 in commercial shipping, and 0.011 in petroleum pipeline movements (U.S. Dept. of Transportation, 1971).

The accident reporting system instituted by the U.S. Department of Transportation shows that the majority of accidents involving pipeline distribution mains and transmission lines have been caused by third-party damage.

Safety actions do represent a minor encroachment on land use in the right-of-way and surrounding area. On the other hand, permissible uses of the right-of-way would provide a benefit by maintaining open spaces which could be utilized for nature trails and other activities which would present no hazard to the buried pipeline.

3.1.12.3 Recreation and recreational values

Prince William Sound area

Maps 1 through 11 in Attachment 2 present recreational resources of the Prince William Sound area. With the exception of hunting and fishing activities, recreational use of most of the area is extremely limited because of its remoteness and general inaccessibility. Most of the area is included within Chugach National Forest.

As presented in Section 3.1.5.1.2, an oil spill could reach many miles of shoreline in the area. In the event of a major spill, recreation in the area would be primarily impacted from an aesthetic standpoint. Hunters and fishermen recreating in an otherwise pristine environment would be visually subjected to oil washing up along the beaches. In addition, oil spills may impact wildlife and local fisheries (see Section 3.1.8.1.2).

Southern California coast and Port of Long Beach

Impacts on recreation resources include: (1) impacts of oil spills from tankers at sea, (2) impacts of oil spills within San Pedro Bay on boating, fishing and beaches, (3) impacts on tanker traffic on ocean recreational boating and fishing, (4) impacts from the proposed tanker trestles and breakwater on boating and fishing opportunities in San Pedro Bay, (5) impacts from dredging, trestle, and breakwater construction on fishing and beaches, and (6) visual impacts on scenic and natural values covered under 3.1.10.1.

In the remote event of a harbor accident or natural catastrophe off the southern California coast, a major oil spill in potentially disastrous temporary impacts on coastal recreation resources could result with impacts analagous to the Santa Barbara oil blowout of 1969. However, it should be noted that the Santa Barbara oil spill occurred over an extended period of time while a tanker oil spill would be almost an instantaneous event, and the magnitude of the Santa Barbara oil blowout of 1969 was probably greater than the probable oil spill from one to two compartments of a large oil tanker (although the total oil spill from the rupture of all compartments of a 165,000-DWT tanker would exceed the volume of the Santa Barbara blowout of 1969). Since neither the precise location and magnitude of a tanker oil spill nor the effectiveness of containment and cleanup can be predicted, assessment of potential impacts on coastal recreation resources cannot be quantified.

Coastal recreation resources detailed in 2.1.12.3 would be jeopardized by potential oil spills from the proposed tanker traffic just as they are by present tanker traffic and oil exploration and development off the southern California coast. Based on a recent study (Tetra Tech, 1976) of oil spill trajectories from potential tanker accidents, the beaches of Santa Barbara and Ventura counties the Palos Verdes Peninsula beaches, beaches from Long Beach to Huntington Beach, and the Channel Islands would be potentially impacted. There is little liklihood of an oil spill reaching beaches of Santa Monica Bay on Orange County beaches south of Huntington Beach.

Chronic small spills occurring during normal off-loading operations may not be contained by booms and cleaned up, and would likely be washed ashore on beaches between the Pacific Terrace Shoreline Park development and the Alamitos Bay jetty. Depending on the quantity and extent of oil damage, this could result in a closure of the affected portion of the beach until cleanup was effected. Recreationists would move to nearby beaches. Recreationists might experience increased problems with "tar" (weathered oil and sand globules) on beaches along Long Beach as a result of these chronic small oil spills associated with terminal operations.

Chronic low levels of oil pollution that might be associated with operation of the terminal would reduce sports fishing in the area. Some fish species might abandon the area. Absorption of hydrocarbons in remaining species might result in sports catches becoming unpleasant tasting and possibly unsafe for consumption. If a reduction in the anchovy live-bait fishery occurred because of increased pollution levels, this would adversely impact both sport fishing in San Pedro Bay and ocean sport fishing originating from San Pedro Bay.

In the remote event of a major oil spill, all water-oriented recreation in the harbor would be temporarily halted until containment and cleanup operations were completed; fisheries would be severely reduced in abundance temporarily until this renewable resource recovered; and recreational boating would be temporarily curtailed. A major maintenance problem would result if a spill should enter a small-craft marina area. Swimming and other water sports would be abandoned until cleanup activities were completed.

Tanker traffic, upon rounding Point Conception to San Pedro Bay, traverses an area of intensive pleasure boating and party boat fishing use. Tanker traffic would conflict with ocean sail and power boating activities, especially in the Santa Barbara Channel-Channel Islands area and the San Pedro Channel between San Pedro Bay and Catalina Island. There would be a remote possibility of tankers ramming small boats which were not able to get out of the way, especially under foggy conditions when visibility was limited (most smaller recreational craft are not equipped with radar).

The tanker trestle and breakwater would effectively reduce the water surface acreage available in San Pedro Bay for recreational boating and fishing and permanently constrict the harbor area south of Pier J. The popular public shore fishing area at the southeast corner of Pier J would either be eliminated or reduced in size (Figure 3.1.12.3-1).

The applicant has not yet furnished detailed site plans showing how much of the Pier J shoreline would be fenced off from public access (fishing) and parking. A worst-case assumption would be the removal of 500 yards of shoreline on the east side of Pier J and 500 yards on the south side of Pier J.

Disturbance of bottom sediments through dredging, trestle and breakwater construction would disrupt the fishing around Pier J for the duration of the construction period and might result in some aesthetically displeasing bottom materials being washed up on the beaches of Long Beach.

Greater Los Angeles urbanized landscape

Impacts on recreation resources would include: (1) visual impacts on scenic and open-space values covered in 3.1.10.2, (2) temporary impacts of construction on recreational trail activities adjacent to Los Angeles River and Rio Hondo channels and Whittier Narrows Recreation Area, and (3) impacts

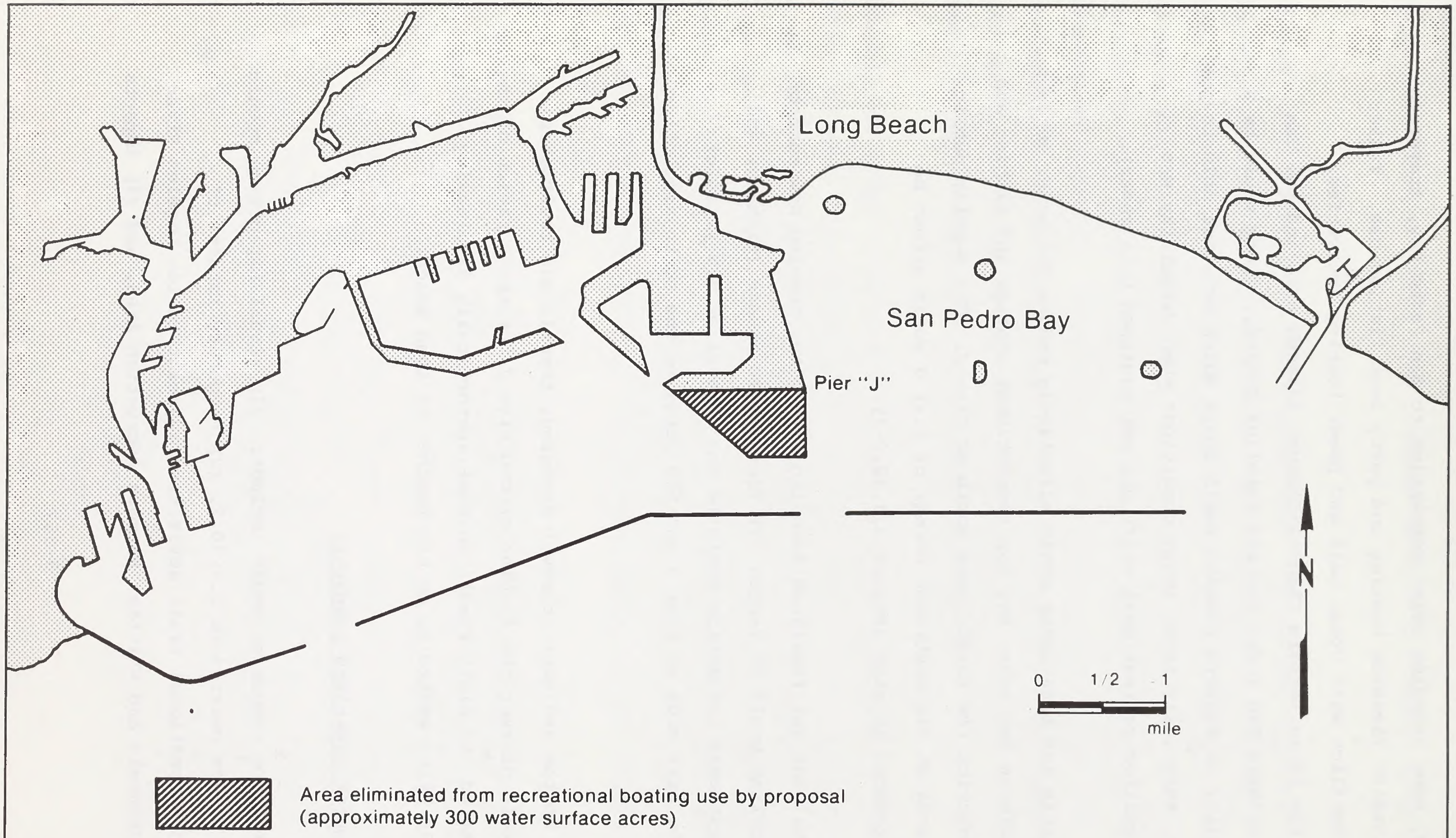
Long Beach
San Pedro Bay
Pier "J"
N
0
1/2
1
mile
▨ Area eliminated from recreational boating use by proposal
(approximately 300 water surface acres)

Figure 3.1.12.3-1 Impact on boating in San Pedro Bay

of operations and maintenance on existing and proposed recreational developments.

Dust, noise, and truck traffic would degrade the recreational environment of parks and recreation areas adjacent to the proposed pipeline right-of-way for the duration of construction activity in the immediate area. This impact is difficult to quantify and relatively minor because of the short duration and the small area (those portions of the park within perhaps 1/8 mile of the construction activity for a period of 1 to 3 months). Park and recreation areas so impacted from Long Beach to Redlands include: (1) Parks: Circle City Park, Virginia Country Club, DeForrest City Park, Houghton City Park, and (2) Recreation areas: Compton Par 3 Golf Course, Rio Hondo Country Club, John A. Ford State Park, Rio Hondo City Park, Grant City Park, Streamland City Park, Candlewood Country Club, Whittier Narrows Dam Recreation Area, California Country Club, and the Diamond Bar Golf Course.

Trails. The equestrian trail along the east side of the channel levee from Willow Street on the Los Angeles River channel to just north of the Santa Ana Freeway on the Rio Hondo channel lies in the proposed pipeline construction corridor. Construction is planned in segments, so that only one segment of trail would be removed from recreational use for any given period of time. In order to protect construction equipment from vandalism and the public from injury, it might prove necessary to close both the equestrian and bicycling trails from one main bridge intersection to the next until construction was completed. Although construction would cause closure of only short segments of trail at any given time, the closure of any segment would cause disruption to the continuous nature of this regional trail system, lasting for the duration of pipeline construction from San Pedro Bay to Whittier Narrows Dam, a period of about one year. Federal Land and Water Conservation Funds are not involved in these trails; hence, Section 6(f) of the Land and Water Conservation Fund Act of 1965 (PL 88-578) does not apply.

The proposed pipeline route would pass through the northern edge of Streamland Park at the base of Whittier Narrows Dam. This park is currently being developed jointly by the Corps of Engineers and the city of Pico Rivera. Depending upon the scheduling of recreational developments, the trench for pipeline installation would be dug through picnic areas, the park road, two baseball diamonds, the sunbathing area adjacent to the pool, the multipurpose courts, and the tennis courts. Disruption would be severe enough to preclude use of much of the park for one to three months, possibly resulting in temporary closure (Figure 3.1.12.3-2). Federal Land and Water Conservation Funds are not involved in this park; hence, Section 6(f) of the Land and Water Conservation Fund Act of 1965 does not apply.

The equestrian area is currently under construction north of the San Gabriel River channel within the Whittier Narrows Dam recreation area. The proposed pipeline route would pass through Corps of Engineers project lands along the Whittier Narrows Recreation Area. However, the pipeline would intersect the paved entry roads to the equestrian area, water and sewage connections for the equestrian area, and possibly the eastern edge of the equestrian area parking lot. Pipeline construction activity would thus result in probable temporary closure of the equestrian area. The proposed pipeline would disrupt the bicycle and equestrian trails on either side of the San Gabriel River from Whittier Narrows Dam. Construction activities would probably involve trenching the equestrian trail, resulting in its closure for about one to three months and cutting off recreation trail access between Whittier Narrows Dam equestrian area and the San Gabriel River trail. Federal Land and Water Conservation Funds are not involved in the equestrian area or San Gabriel trails; hence, Section 6(f) of the Federal Land and Water Conservation Act of 1965 does not apply.

Pipeline construction in San Timoteo Canyon would create noise, dust, and truck traffic that would be a source of irritation for one to three months for sightseers on county roads and recreationists using small private El Casco Lakes development.

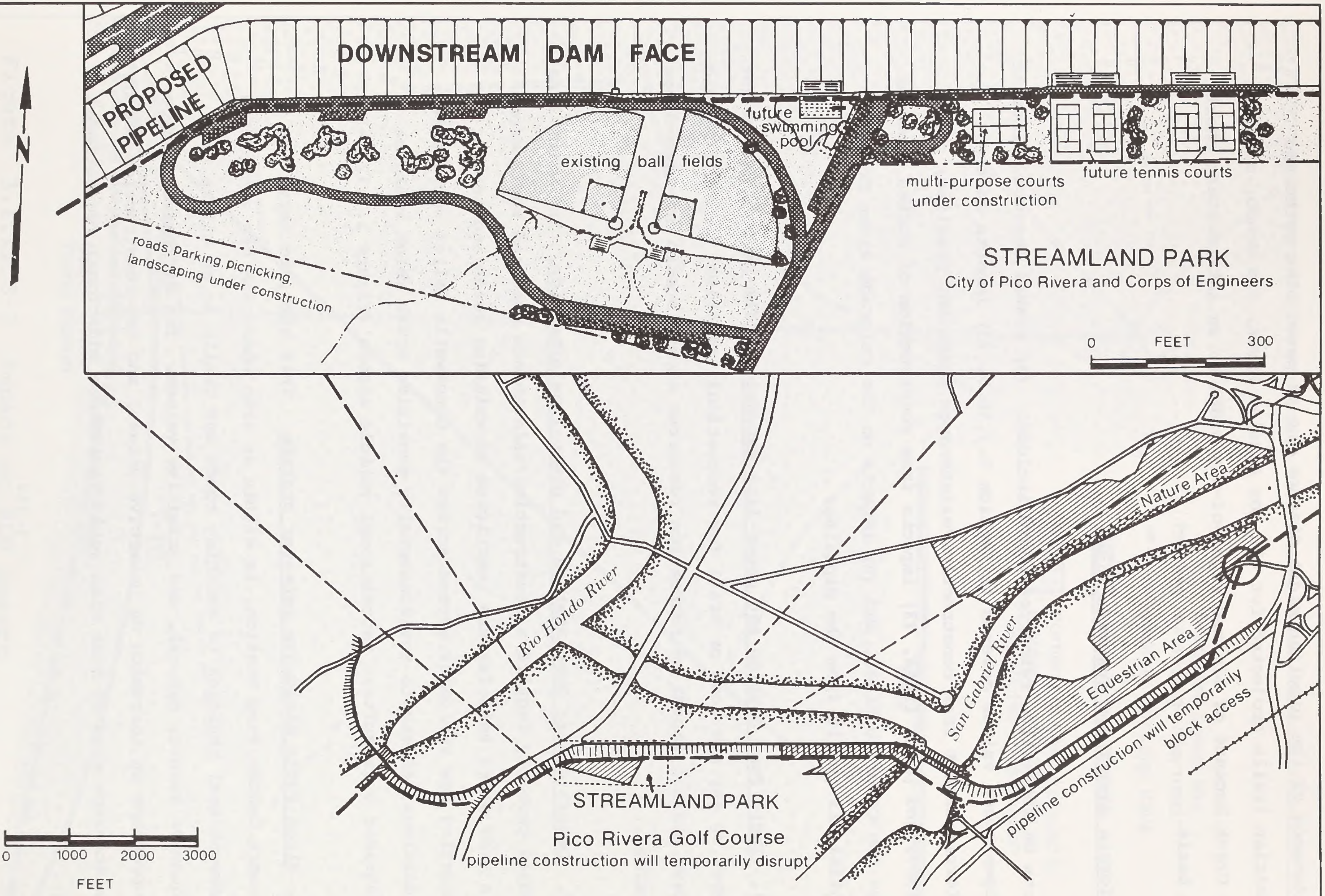

Figure 3.1.12.3-2 Impact on recreation reserves-Whittier Narrows Dam

Maintenance of the pipeline might disrupt use of paved bike paths and equestrian trails projected for the Los Angeles River, Rio Hondo, and San Jose Creek because of limited right-of-way width on an intermittent short-term basis.

California desert and Colorado River

Impacts on recreation resources would include: (1) visual impacts on scenic and open-space values covered in Section 3.1.10.3, (2) impacts on the California desert from construction/maintenance roads for pipeline, pump stations, and power lines, (3) impacts from construction of buried pipeline across the Colorado River, and (4) impacts on the Colorado River from potential oil spills from the pipeline.

1. Indio Pump Station and power-line extension. The proposal would not open up any new road or trail for recreational vehicles; hence, it would have minimal impact on recreation resources except scenic and open-space values.

2. Desert Center Pump Station and power-line extension. The power line would probably require a construction/maintenance road and would cross an area where vehicles are restricted to existing roads and trails. Creating new vehicular access across the Chuckwalla Valley would offer additional access to environmentally sensitive areas which would be degraded by resultant recreational vehicle abuses (Figure 3.1.12.3-3).

3. Black Butte microwave repeater station. This site, to serve the Desert Center Pump Station, is within an area where BLM has restricted recreational vehicles to existing roads and trails in an effort to conserve scenic, natural, and primitive values. The microwave repeater represents an intrusion on primitive values, and any construction and/or maintenance road to this site would facilitate additional recreational

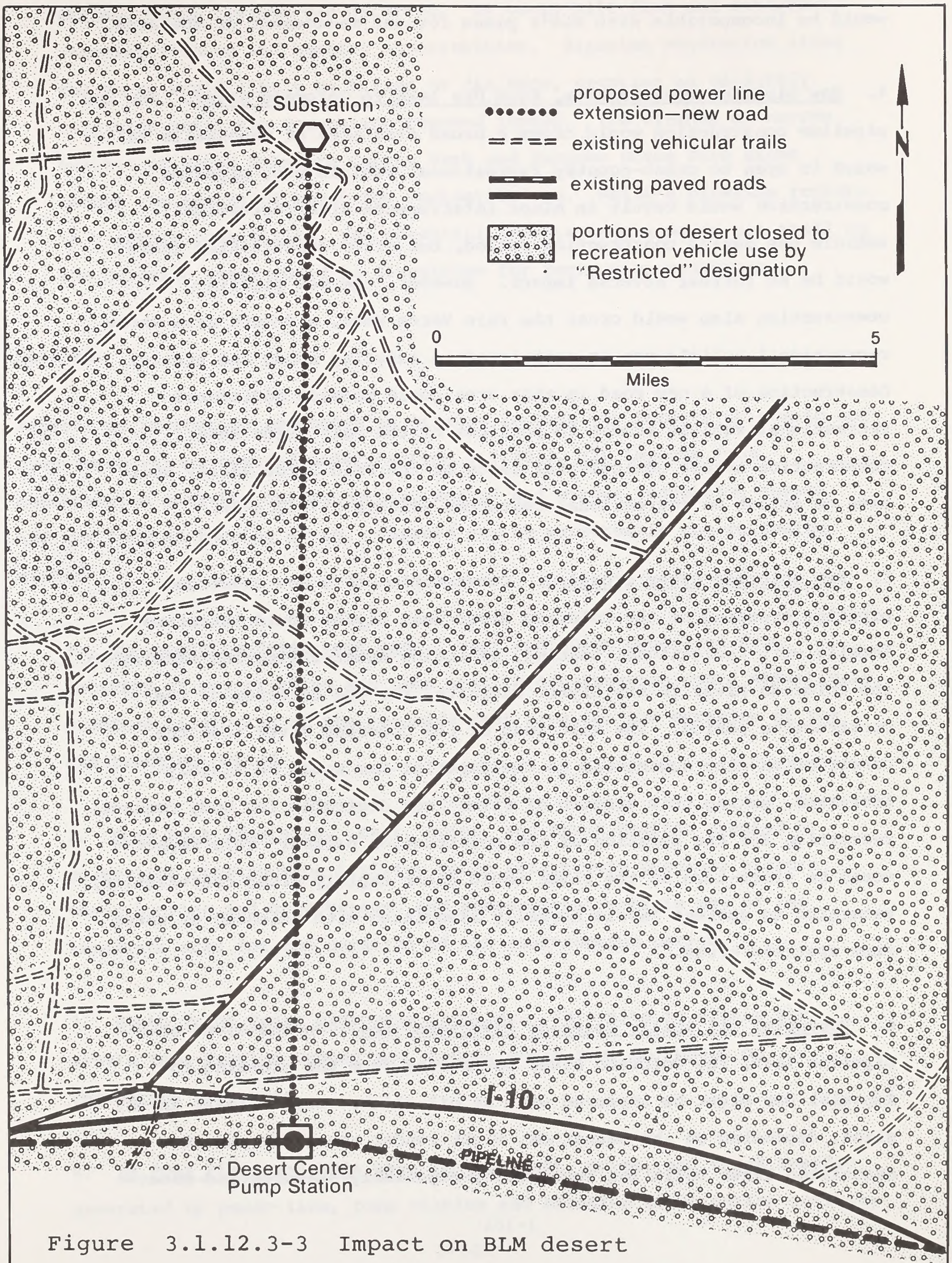
Substation
proposed power line extension—new road
existing vehicular trails
existing paved roads
portions of desert closed to recreation vehicle use by "Restricted" designation
N
0
5
Miles
I-10
PIPELINE
Desert Center Pump Station

Figure 3.1.12.3-3 Impact on BLM desert vehicle management program

vehicle use of this environmentally sensitive desert area and, hence, would be incompatible with BLM's plans for and management of the area.

4. New pipeline construction, Ford Dry Lake to Colorado River. The new pipeline construction would cross a broad flat area of Chuckwalla Valley which is open to cross-country recreational vehicle use; pipeline construction would result in minor interference with recreational vehicle use during construction period, but after construction there would be no further adverse impact. However, the new pipeline construction also would cross the Palo Verde Mesa, a desert area where recreational vehicle use is restricted to existing roads and trails. Construction of a new road in this area could provide additional recreational vehicle access to portions of the Palo Verde Mesa. Construction across agricultural lands of the Palo Verde Valley would have no impact on recreational resources (Figure 3.1.12.3-3).

5. New Colorado River crossing. Construction of a new submerged pipeline crossing of the Colorado River near Blythe would interfere locally with recreational boating, including water-skiing and fishing on the Colorado River in the Blythe vicinity, for the duration of the construction period. The silt load of the Colorado River from the construction site downstream to the Imperial Dam would be visibly increased, making this stretch of river less desirable for body contact recreation for the duration of the construction period. This impact would be short-term as the river would clear rapidly after construction, returning to ambient levels normally associated with releases of water from upstream areas.

6. Potential oil spill, Colorado River crossing. In the event of a pipeline leak, the Colorado River downstream from the crossing to Imperial Dam might be impacted with an oil slick. Such a leak, an oil slick, depending on its magnitude, might render the river and its associated lakes unfit for recreation, especially swimming and water-

skiing, until cleanup was effected. It could kill fish and waterfowl, reducing fishing and hunting opportunities. Riparian vegetation along the banks would likely be killed or die back, creating an unsightly condition until the vegetation renewed itself. The cleanup of narrow beaches at Peter McIntyre County Park and Picacho State Park might reduce the amount of beach for recreation use. While a pipeline rupture is a remote possibility, the potential impacts from a major oil spill on the Colorado River would be disastrous for recreation resources.

Arizona

Impacts on recreation resources in Arizona include (1) impacts to scenic and open-space values covered under Section 3.1.10.3, (2) impacts from construction activity during hunting season and winter recreation season, and (3) loss of hunting areas. Impacts may be expected in the following areas:

1. Ehrenberg roadside rest area. Dust and noise generated from activity of new pipeline and pump station construction would effectively preclude picnicking at the roadside rest area for the duration of the construction period.

2. Dome Rock Mountains. Dust, noise, and truck traffic created by power-line construction activity would effectively preclude bighorn sheep hunting and observation, and recreational-vehicle use of the immediate area for the duration of the construction period.

3. South Trigo Peaks microwave repeater. This site is within the Army's Yuma Proving Ground and, hence, would have no impact on recreation resources.

4. La Posa Plain and Kofa Game Range. Dust, noise, and truck traffic generated by power-line, pump station and pipeline construction activity

might bother "snowbirds" in their traditional extended-stay camping areas, including the developed Crystal Hills campground, during the winter periods of construction. Some "snowbirds" might be expected to object to this intrusion, while others would view it as a source of interest. Many would be displaced to other portions of the Arizona desert. Recreational use of the northern portion of the Kofa Game Range, including rock hounding, sight-seeing on primitive roads, photography, hiking, etc., would be curtailed for the duration of the construction period.

5. Arlington Wildlife Refuge and Gila Greenbelt. Dust, noise, and truck traffic generated by power-line construction activity might interfere with quail and waterfowl hunting in the immediate area of the proposed power line for the duration of the construction period.

6. Black Mountain. Dust, noise, and truck traffic generated by pump station and power-line construction would interfere with dove and quail hunting in the immediate area for the duration of the construction period. The Black Mountain Pump Station would eliminate in excess of 10 acres of prime dove and quail hunting area.

7. Coronado National Forest. No construction is proposed on the existing right-of-way through the Winchester Mountains.

New Mexico

Impacts on recreation resources from construction operation and maintenance of the project include: (1) impacts on scenic and open-space values discussed under Section 3.1.10.3, (2) the remote potential for oil leaks at the Rio Grande and Pecos River and (3) impacts from power-line maintenance roads.

An oil leak on the Rio Grande would adversely affect fishing and waterfowl hunting for an indeterminate distance downstream. An oil leak on the Pecos River crossing would affect fishing and waterfowl hunting, as well as boating and water-skiing downstream to the Red Bluff Reservoir.

The power lines serving Lordsburg and Pecos pump stations would presumably result in construction and maintenance roads that could open up new access to recreation vehicle users, a positive benefit for motorized recreationists and a negative impact for nonmotorized recreationists. (The capability of this area to attract nonmotorized recreational use is relatively low; thus, power-line maintenance roads would probably be a net positive benefit.)

The proposed project has no impact on recreation resources of Shakespeare-Aberdeen Ghost Town/Historic Mining Area or Rock Hound State Park.

Texas

Adverse impacts on recreation resources include: (1) visual impacts described in 3.1.10.3 and (2) the remote potential for oil spill impacts on Pecos River-Red Bluff Reservoir.

An oil spill at the Pecos River crossing from a pipeline leak or rupture could spread over Red Bluff Reservoir before containment and cleanup. Oil on the reservoir would preclude boating, fishing, water-skiing, and swimming at this popular recreational area for an indeterminable period until cleanup could be completed.

Cumulative impacts -- year 2000

No cumulative impacts on recreation are anticipated from pipeline construction.

3.1.13 Use plans, controls, and constraints

3.1.13.1 Coastal, Sea Leg, and Port

3.1.13.1.1 Conversion/construction

As described in Chapter 1, Section 1.2.2, the marine construction activities would be directed by the Long Beach Port Authority and would involve dredging and spoil disposal, pile installation, trestle and berth construction, and installation of a breakwater.

The proposed breakwater would be marked with the required aids to navigation along the berthing area and trestle. All of the new construction and aids would be added to the navigation charts of the area. An oil spill contingency plan (Woodward-Clyde, 1976) would be submitted to the U.S. Coast Guard for approval at least six months in advance of the initiation of terminal operations. Jacobsen Pilot Service, Incorporated, would pilot the tankers to and from the berthing area. This would add approximately one entering and leaving operation per day for the pilot company. The company would be able to handle this increase. The Port is requesting that tankers be berthed with their sterns facing east so that in an emergency the tankers could leave the berthing area under their own power.

The berthing area would meet all the safety regulations required by the regulatory agencies of the area.

The terminal would be in an area that is already developed; therefore, construction of the terminal would be in accordance with the policy set forth in the California Coastal Plan.

The terminal would be in accordance with all policies of the City of Long Beach, the Port of Long Beach, and all state and Federal agencies, and the California Coastal Plan.

Existing policies

Among those agencies having regulatory power over the project is the California Coastal Zone Conservation Commission. Policies evolved by the agency and applicable to the project include proposals for maximum use of existing tanker facilities including multicompany use of existing facilities; strict tanker facility siting criteria with heavy emphasis on potential environmental impacts; and criteria for Port development involving filling or dredging calling for a demonstration of need and a minimizing of adverse environmental impacts.

Other related policies call for an evaluation and incorporation, where feasible, of public-oriented uses where major coastal energy or public service facilities are planned, and consideration for aesthetic sensitivity (California Coastal Zone Conservation Comm., 1975).

Regulations in force and applicable to the project include those of the U.S. Army Corps of Engineers, California Department of Fish and Game, and California Water Quality Control Board. These agencies would concern themselves with minimizing impacts of dredging and filling operations attendant to the project.

Year 2000

There are no foreseen conflicts of policies on the future environment.

Conflicts

Background documents supportive of the California Coastal Plan suggest that the encouragement of smaller vessels and maximum utilization of existing Port facilities will continue for as long as feasible, though this means more traffic and possibly greater risk of spillage; and when the need is demonstrated, there would be creation of offshore mooring for supertankers, away from metropolitan (critical air) and ecologically sensitive estuary areas, or in other areas where ocean depth and sea-bottom configuration allow the greatest distance from the facility to the shore.

It is further pointed out that in order to protect the coastal environment, it will usually be preferable to site petroleum storage tanks inland, minimizing coastal sites, and allowing them only if and when a need has been absolutely demonstrated that cannot be met by inland sites.

In discussing piers, trestles, etc., the Coastal Commission recommends that any extension in excess of about 50 yards in length designed to accommodate a vessel in excess of about 70,000 DWT would most likely exceed the cost of a monobuoy. A rigid pier also does not have the safety potential hazard to shipping (California Coastal Zone Conservation Commission, 1974).

These apparent policy conflicts would have to be addressed by the California Coastal Zone Conservation Commission at the time the applicant's proposal is submitted for review and permit.

3.1.13.1.2 Operation

Existing policies

The California Coastal Zone Conservation Commission has adopted policies which call for the strict regulation of the release of toxic substances into the marine environment; specifically, the siting, design, and operation of petroleum facilities shall not be permitted when the risk of accidental spills would have an adverse impact on environmentally sensitive or highly scenic areas.

Conflicts

The site the applicant has chosen for the storage tanks, Pier J, would appear to be in conflict with the above referenced policy unless it could be conclusively demonstrated that an alternative site was not available and/or feasible and that the risk of an accidental oil spill on Pier J could be effectively mitigated.

3.1.13.2 Land use

3.1.13.2.1 Conversion/construction

Existing policies

Land-use policies applicable to the project are consistent throughout the urbanized areas along the route. Most jurisdictions view utility corridors as necessary elements in the urban infrastructure and have accommodated them.

In trying to encourage orderly and balanced developments, policies formulated by the urbanized areas propose that new development be concentrated in places able to accommodate it (i.e., areas with adequate water supply, sewer service, road and other transportation facilities, etc.).

New development is encouraged not to leapfrog or sprawl over open lands but instead be directed to already developed areas.

In rural areas, lands designated for open space, recreation, agriculture or open-grazing utilization are, for the majority of the route, interlaced with a variety of existing utility corridors (i.e., transmission lines, rail lines, natural gas pipelines, etc.).

The designations assigned by local jurisdictions along the route and the policies attendant thereto are not very explicit in providing guidelines for the types of uses allowable in the rural areas. The various state and Federal guidelines are not much more definitive.

Conflicts

Open space may be defined as any parcel or area of land or water which is essentially unimproved and devoted to an open-space use such as (1) open space for the preservation of natural resources, (2) open space for the changed production of resources, (3) open space for outdoor recreation and (4) open space for public health and safety.

In the strictest sense it could be argued that intrusions into open-space areas by power lines, roadways, pipelines, etc. conflict with the open-space protection policies inherent in most general plan classifications for rural areas, recognizing that certain intrusions (i.e., power lines, roadways, etc.) are necessary to most fully utilize certain agricultural, recreation or open-space uses but represent aesthetic and visual constraints to the natural landscape.

It is hard to rationalize compatibility of the placement of compressor stations, pump stations, and utility substations on open land with open-space designations. These uses must certainly be classified as industrial in nature and their imposition on open spaces is viewed in most cases as an adverse impact.

Present land use would be preempted for installation of the pump stations (approximately 90 acres), maintenance bases (70 acres), temporary storage areas (64 acres), temporary construction right-of-way for the new pipeline installation (907 acres), and the terminal areas (87.5 acres).

3.1.14 Transportation networks

3.1.14.1 Marine

The addition of the SOHIO tanker fleet to the existing vessel traffic patterns adds about 267 vessel round trips to the traffic patterns of the West Coast. The effect is to increase the likelihood of collision for other vessels along the route. In waters south of Cape Mendocino, the collision hazard increase for a specific vessel is negligible because of the heavy traffic that already exists. However, on the Sea Leg portion from Hinchinbrook Entrance to Cape Mendocino, the probability of a collision for a non-SOHIO vessel increases by about 50 percent. Within Valdez Arm, the increase is about 25 percent (Tetra Tech, 1977).

SOHIO ships will transit areas that are used by commercial and recreational boaters. There will be an average of 1.4 vessel transits daily. These transits can be hazardous to the boat or small ship operator that does not maneuver his craft in a prudent fashion. The hazard is greatest in areas of significant commercial fishing or recreational boating such as exists in Prince William Sound and in the Santa Barbara Channel (Tetra Tech, 1977).

3.1.14.2 Port of Long Beach and terminal area

Construction

Harbor traffic and dredging. Construction of the proposal should not impact on the number of vessels entering or leaving the harbor. During construction, there would be an impact from the proposed hopper dredge because of its movement in and out of the harbor and the hazard while dredging.

Street system. On the basis of the Port of Long Beach's estimate of a peak construction force of 360 employees at the Port, Crommelin-Pringle and Associates, Inc. (CP&A) estimate that average daily traffic would increase by 900 vehicles in the Port area, with directional peak-hour flows of 260 vehicles (Port of Long Beach and California Public Utilities Comm., 1976). The daily trips per employee were assumed to be 2.5. The directional peak-hour volumes were derived assuming that 80 percent of the work force would arrive at or leave the site in a one-hour period with an average occupancy of 1.1 persons per vehicle.

The estimated distribution of site traffic was based on data obtained from the California Department of Transportation concerning projected work trips to the Port area from the Los Angeles region. It is estimated that 61 percent of the work trips would be to and from the north via Harbor Scenic Drive and the Long Beach Freeway; 23 percent to and from the east via the Queens Way Bridge-Shoreline Drive-Ocean Boulevard; and 16 percent to and from the west via Ocean Boulevard.

The additional traffic accessing the Port area would have no noticeable impact on routes to the north or west because major traffic flows would be in the oncoming lanes. Only to the east along Ocean Boulevard would the additional traffic add to existing street capacity problems. Approximately 60 vehicles would be added to the nearly 1,000 vehicles presently using the incoming (morning) and outgoing (evening) street lanes during peak-hour periods.

The intersection of Harbor Scenic Drive and Panorama Drive would absorb all traffic generated by construction, an increase of approximately 30 percent in peak-hour traffic traversing the intersection. This might cause increases of several minutes in vehicle travel times through the area.

The route of the pipeline to be constructed from the oil terminal would cause temporary disruptions of traffic within the Port area at Panorama Drive, Van Camp Street, Harbor Plaza, and Pier J Avenue.

Year 2000 -- General plan development within the Port of Long Beach by the year 2000 will generate 3,000 more vehicles inbound during the afternoon peak hour. Average daily traffic will be increased by 12,500 vehicles. These estimates by the Port of Long Beach are based upon an increased work force of 5,000 employees and upon traffic generation factors developed from studies made by the California Department of Transportation (CalTrans), the City of Los Angeles Traffic Department, and other traffic engineering agencies (Port of Long Beach, 1976).

Although no major street improvements are presently planned that would significantly increase traffic capacities, measures would be required if traffic problems of large magnitude are to be curtailed. The future traffic problems would be generated largely from projects proposed outside the Port boundaries.

Parking. The provision of temporary onsite parking at a ratio of one space per employee would be sufficient to accommodate total parking demands. At peak employee levels, the parking facility would have 356 spaces and require a lot approximately 2.5 acres in size. This would have no adverse impacts.

Truck and rail traffic. Peak truck traffic would produce an additional 30 truck trips per day on Harbor Scenic Drive near the site (Port of Long Beach and California Public Utilities Comm., 1976). This should cause no serious adverse impact upon the transportation systems. Construction materials would be transported to the site exclusively via truck; therefore, no construction impacts would occur on existing rail operations.

Year 2000 -- The Port of Long Beach estimates that ocean-borne commerce will double after implementation of the general plan. With the exception of petroleum, which is transported via pipeline, the cargo will be transported by rail or truck to the market areas. As a result, rail and truck movements can be assumed to nearly double. The main-line rail system serving the Port has ample capacity to accommodate this increase in demand of about 100 rail cars per day. A 100 percent increase in port-related truck traffic will incrementally contribute to the area-wide traffic congestion during peak periods. The street systems within the Port that will absorb a relatively high percentage increase in truck traffic will primarily be Harbor Scenic Drive and Pico Avenue.

Operation

No new types of transportation facilities would be added as a result of this project except the oil pipeline leading away from the terminal. No existing transportation facilities would be eliminated.

There would be an increase of approximately one tanker per day entering and leaving the Port. This is an insignificant increase which would cause an insignificant increase in the accident rate of the Port.

The vehicular traffic generated by the normal operational work force would be approximately a maximum of 60 directional peak-hour trips. Materials and equipment deliveries by truck and rail would be infrequent and of small magnitude (Port of Long Beach and California Public Utilities Comm., 1976).

Operational impacts would be offset to some degree by elimination of present land uses in the project area. This factor has not been quantified. However, even without this consideration, no significant impacts on land transportation facilities within the Port of Long Beach area are predicted as a result of project operations.

Year 2000 -- The types of transportation systems within the Port of Long Beach will not have changed by the year 2000. Extensions of existing systems will certainly occur, with maximum extension being caused by full implementation of the general plan. If the general plan is not implemented, the cumulative impacts will be less severe.

There will be a considerable amount of dredging and filling within the Port between 1980 and 2000 if the general plan of the Port is implemented. The dredging operation and the probable tug and barge traffic bringing in rock from Santa Catalina Island will result in a navigation hazard.

The following information has been extracted from the Draft Environmental Impact Report, Proposed General Plan, 1975, Port of Long Beach, Volume 1, Appendix C:

> An increase in peak daily ship traffic [1,280 vessel movements per year] would not cause any significant operations problems within the harbor area. Based on historical ship collision accident data for the combined Los Angeles/Long Beach port, the collision rate is now approximately one collision for 2,500 movements. If this collision rate remains constant, the additional ship traffic generated by the expansion of the port would result in an additional collision every two and one-half years. This estimate is considered to be conservative (i.e., high) because there have been no vessel accidents in the Port of Long Beach itself in recent years. By the year 2000, the VTS proposed for the port by the United States Coast Guard will be operational and may further reduce the historical collision rate, which is now very low in comparison to United States ports in general.
>
> It is not anticipated that water traffic generated by naval . . . activities within the port will change significantly between now and the year 2000. The United States Navy has no current plans for expansion of the Long Beach Naval Shipyard . . . .

3.1.14.3 Pipeline route crossings, including rail, highways, water crossings, etc.

Conversion/construction

The proposed pipeline would consist of approximately 1,026 miles of crude oil pipeline containing 30-inch, 42-inch, and 48-inch outside-diameter line pipe. A total of 787.7 miles of 30-inch line pipe is in place and represents the existing gas pipeline systems. The 30-inch pipe system is proposed to be converted from natural gas to crude oil service. New line pipe would be used for approximately 245.8 miles.

Types

Exposed line pipe. In the new section of pipeline there would be certain locations where main-line pipe would be exposed, creating aesthetic impacts to some observers. These would occur in Los Angeles where the crossing of concrete-lined watercourses prevents burying the pipe. The most notable of these is the Los Angeles River.

In the existing pipeline sections there are locations where the pipe is exposed in a "span" (see Table 3.1.14.3-1).

Table 3.1.14.3-1

Exposed Line Pipe in Existing Systems

OWNER	Number of Spans	Average Length (feet)	Maximum Length (feet)	Total Length (feet)
Southern California Gas Company	50	93	267	4,656
El Paso Natural Gas Company	17	41	70	698

Foreign pipeline crossings. Foreign pipelines are described to be existing pipelines owned by other pipeline companies. Crossing another pipeline requires notification of the owner company and the exact nature of the crossing procedure is determined. Pipelines which would be crossed by the new sections and existing sections of proposed pipeline were tabulated from state and county maps, and were listed in Chapter 1 for pipe of 6 inches or larger. Accidental rupture of one of the existing pipelines during construction activities could have major or minor impacts on soil, water, air, visual resources, public safety, and other environmental components, depending on the type and amount of material released.

Water crossings. The new pipeline would be buried at all water crossings, except for crossing of concrete-lined watercourses such as the Los Angeles River. Water crossings on the existing pipeline would be examined to ensure their adequacy and integrity. There are two exposed crossings on existing support structures, namely the San Pedro River and Pecos River crossings. The potential for accidental rupture of the pipeline during operation is considered to be the greatest potential impact on waterways crossed by the project.

Conflicts

California. Transportation routes, as referenced in the preceding sections, abound in the three-county area in the pipeline route. The pipeline route along the Los Angeles River flood control channel in Los Angeles County would receive the strongest level of environmental impact because of intensive urbanization of the area. Short-term disruptions resulting from construction would include increased levels of noise and dust. The flood control channel is presently fenced; however, additional fencing may be provided locally. The city traffic should be only minimally interrupted since existing transportation corridors are primarily confined to overpasses.

The terminal at Long Beach would take approximately 16 months to construct and represents the impact of the greatest duration. This impact is anticipated to disrupt existing rail and truck traffic temporarily in the harbor areas as well as displacing existing land uses in the harbor such as the foreign automobile impound areas which would have to be relocated elsewhere in the Los Angeles-Long Beach harbor complex.

The following 55 miles through a moderately urbanized area traverses San Bernardino County and a portion of Riverside County to the vicinity of Beaumont. This area is mixed urban, agricultural, and open-space land. Construction through this area would temporarily disrupt local traffic as the planned construction rights-of-way would follow, for the most part, local roads or other transportation corridors.

Arizona. Few significant impacts are associated with the project on transportation networks through Arizona because most of the pipeline is already in the ground. The new construction through the Kofa Game Range is expected to disrupt local recreation traffic temporarily, and the normal construction activities associated with the proposed new pump stations would create additional traffic burdens on existing local roadways.

New Mexico. With only 15 miles of new pipeline construction in New Mexico, the anticipated impacts on existing transportation networks would be minimal. As in the case of Arizona, the construction of new pump stations would create additional traffic burdens on existing local roadways.

Texas. Midland would be the principal community impacted in Texas. Short-term disruptions to local traffic flow could be expected in the Midland area which is a rapidly growing city of approximately 65,000.

3.1.14.4 Cumulative impacts on transportation networks (year 2000)

A total crude oil production rate of about 250,000 bbl/cd is estimated for southeast New Mexico and Texas Railroad Districts 7B, 7C, 8, and 8A in the year 2000 (De Gloyer and MacNaughton, 1975). Existing refining capacity in the southeast New Mexico and Midland area is currently rated at 299,000 bbl/cd. The crude oil provided by the proposed project could enable continued capacity operation of these facilities and local petrochemical operations without importation of raw materials from the Gulf area. The existing pipeline capacity out of the Midland area could accommodate the 500,000 bbl/cd rate projected for the proposed project.

3.1.15 Utility networks (electricity, gas, water)

3.1.15.1 Port of Long Beach and terminal areas

Conversion/construction/operation

Electrical service is provided to the Port of Long Beach primary facilities by the Southern California Edison Company at an annual estimated rate of 322.8 million kilowatt hours (kwh) which represents approximately 0.6 percent of the service area demand. There is an intricate network of transmission lines existing and proposed within the Port. The existing network is distributed by two substations, located in the flood control channel between Third Street and Broadway (the Seabright substation and Pico substation).

If load demands increased in the harbor, additional substations would be constructed to distribute power. The operation of the Port facilities and Dominguez Hills terminal would require approximately 100 million kilowatt hours of electrical power per year.

Natural gas is supplied to the Port by the Long Beach Gas Department at an annual estimated rate of 62,384 cubic meters (2,220,300 cubic feet). This is approximately 0.011 percent of the city-wide demand. The project is not anticipated to impose any additional demands for natural gas service.

Water would be used at both terminal sites for normal employee domestic usage, cooling of pumps and drivers, and washdown operations. The estimated usage amounts to about 20 gallons per minute (gpm). In Long Beach, the supply could be obtained from the City of Long Beach Gas and Water Department. At the Dominguez Hills terminal, water would be supplied by the Dominguez Water Company. At either location the normal usage would represent only a very minor portion of the current capacity of the utility group and would present no problem.

Water needed for hydrostatic testing of both new pipeline, sections of the existing gas pipeline, and storage tanks would be obtained from various public and private sources and along the route as proposed in Section 1.2.2.1 and Table 1.2.3.2-26. Amounts of water to be used range from 54,300 barrels to 527,900 barrels for the pipeline and 845,000 barrels for storage tanks. No adverse impacts are expected on public water supplies as a result of removal of these amounts of water.

The major adverse impact related to utility networks would occur if, during construction, an existing utility conduit (gas, electricity, telephone, etc.) were broken. This impact would most likely occur during construction activities. The severity would depend upon the type of utility that was damaged and how long it remained out of service.

3.1.15.2 Pipeline route

Conversion/construction/operation

The proposed Indio Pump Station would be served by Southern California Edison by tapping an adjacent existing 230 kv transmission line.

At the proposed pump stations at Redlands and Desert Center, power would be provided by Southern California Edison by tapping existing 66 kv transmission lines. Permanent access roads would be required for construction and maintenance of these transmission lines (taps of 2.7 miles for Redlands and 11.8 miles for Desert Center).

The power lines accommodating the various pump stations and cathodic protection facilities along the route would require periodic maintenance. Routine maintenance practices should cause no adverse impacts to the environment.

The proposed pump stations at Ehrenberg, Livingston, Gila, and Casa Grande would be provided power by BIA or San Carlos Irrigation District. Coolidge and Black Mountain pump stations in Arizona would be provided power from Arizona Public Service Company. Sulphur Springs Valley Electric would provide power to the remaining proposed pump stations in Arizona at Redington and Cochise. Construction of new transmission lines would be necessary. This service would be accomplished by tapping existing transmission lines and extending new lines to each pump station. The power-line tap to Ehrenberg would be extended 16 miles over the Dome Rock Mountains; the power-line tap to the Cochise station would be 32 miles long.

Public Service Company of New Mexico would construct the necessary transmission line taps to facilitate power to the proposed Lordsburg, Deming, Anthony, and Pecos River pump stations in New Mexico.

Clearing of the right-of-way would be accomplished as required for construction of the line and access roads. Approximately 32 miles of new transmission line would be required to serve Pecos Pump Station in Eddy County, New Mexico.

At the Guadalupe Pump Station in Culberson County, Texas, the Rio Grande Electric Cooperative would provide extended service from an existing line servicing the Dell City substation. It would be necessary to rebuild a 1-mile tap and replace an existing transformer. Construction of the transmission line to serve the El Paso Pump Station is dependent upon obtaining necessary certificates from the Public Utility Commission of Texas and obtaining an agreement from Rio Grande Electric Cooperative, Inc. to tap the cooperative's existing transmission line.

3.1.16 Socioeconomic conditions

3.1.16.1 Sea Leg

The Sea Leg would provide direct income and tax revenues to the Los Angeles-Long Beach area of approximately $48.6 to $61.5 million per year. This represents a very small amount in comparison to the 1971 personal income in Los Angeles, Riverside, and San Bernardino counties of $55 billion (U.S. Water Resources Council, 1974). The range represents the difference between the 11 SOHIO-owned tankers and the 14 total tankers believed necessary to transport the oil for the project (11 SOHIO plus three non-SOHIO). See Table 3.1.16.1-1.

Table 3.1.16.1-1

Annual Direct Income and Tax Benefits to Port Area

EXPENDITURE DESCRIPTION	SOHIO Tankers	Total Tankers
Salaries	$12,460,000[a]	$15,800,000
Provisioning	550,000	700,000
Deck stores	880,000	1,120,000
Bunkering	28,660,000	37,190,000
Shore-based personnel	360,000	458,000
Pilot fees	481,000	612,000
Tug fees	900,000	1,145,000
Wharfage	3,800,000[b]	3,800,000[b]
Dockage	500,000	700,000
Total	$48,661,000	$61,525,000

Source: SOHIO Transportation Company.

[a] Maximum amount. Undetermined portion may be spent outside area depending on residence of seamen.

[b] Assumes 700,000 bbl/d.

Approximately 60 percent of the money spent in the area would be on bunker fuel. Second in importance would be the salaries paid to the ships' crews, and this would amount to 26 percent of the economic benefits. The third important item would be wharfage fees. This is a tax levied by the Port at the rate of $0.015 on each barrel of oil to be pumped ashore, and amounts to 6 percent of the total spin-off.

Approximately 800 crew members would be hired to man the 14 tankers. Half would be working while the other half were on leave.

Potential impacts of project operations on fishing industry

Background. The commercial fishing industry has traditionally been one of the mainstays of the Alaskan economy. In the eastern Gulf of Alaska, fishing for salmon, crab, shrimp, clams, scallops, herring, halibut and other bottom fish has been a means of support and a way of life for many Alaskans. Commercial fishermen from Washington, Oregon, Canada and other foreign countries also use the area (USDI, 1976). For a more detailed analysis, see Section 3.1.8.

Impact on commercial species. Interference with Alaska's fishing industry and a reduction in the production of commercially important marine finfish and shellfish could result from the proposed project. Salmon fishing is one of the most important activities (more than 41 million pounds caught in 1973) in the area. It is concentrated nearshore and in numerous bays and fjords. Pink, sockeye, chum, coho, and chinook, in decreasing order or abundance, are the species caught.

Many intertidal spawning pink salmon spend about one-half of their two-year lives in shallow salt water. Salmon are most vulnerable to oil on the water when emerging from spawning areas and during their early life stages in shallow inshore waters. Because they live and feed in the upper (less than 30 feet) layers of the open ocean, adult salmon would also be adversely affected by oil in the water.

Herring, halibut, and other ocean species provided about 24 million pounds of fish to fishermen in 1973. Herring would be adversely impacted if the vegetation they spawn upon were covered with oil. Their planktonic foods would also be adversely affected by oil on the water. These effects would reduce the numbers of fish available.

Attempts to quantify fishery harvest losses from a hypothetical oil spill can be extremely misleading because of the great number of variables. An assumed spill of 100,000 barrels might interrupt fishing for roughly 61 days. The result could be a 500-square-mile oil slick, which, if on the Prince William Sound fishing area, could result in an 804,345-pound reduction in fish caught (based on 1973 catch and value figures and rough estimates of 7,500-square-mile area.)

This presumes that no fish would be taken for 60 days and that half the median number would be taken the next 60 days. Some $259,625 in fishing revenues would be lost, assuming that the catch in the affected area is salmon, other finfish, and shellfish. Relative importance of each species is based on 1973 poundage of each species landed. Value is assumed to be $800 per ton for salmon, $400 per ton for other finfish, and $560 per ton for shellfish.

Oil spills do the most damage to drift-gill nets and crab pots. Drift-gill or set nets become unusable if oiled to a large degree. Oil not only fouls crab pots and long lines, but makes fishermen unwilling to recover pots and long lines for fear of contaminating more gear. Similarly, seine-gill-net, purse-seine, and trawl fishermen are unable or unwilling to fish until an oil slick has disappeared.

Fishing gear losses are also expected to increase as vessel activity increases. Crab-pot and halibut long-line buoys are unlighted and difficult to see at night without a searchlight. Set nets extend from shore, generally away from vessel traffic. Seines and trawls are fished during daylight, making identification and avoidance easier.

Accidental and chronic oil spills and associated use of chemical dispersants would adversely affect commercially important shellfish and finfish. For a detailed discussion of the impacts on marine life refer to Section 3.1.8.1. The adverse impacts of the above causal factors could cause a decrease in commercially important shellfish and finfish with a resulting decrease in harvests.

In summary, oil spills could have both temporary and long-term impacts on commercial fishing. Many fish populations not directly reduced by oil pollution might be tainted with hydrocarbons and therefore be unmarketable. Rogers (1974) reported that the actual adverse effects on the fish and fisheries would depend on a number of factors that are not known at present. It would be necessary to know the precise details of a crude-oil spill in order to determine the precise impacts on commercial fishing activities. However, if fishing efforts were concentrated outside the contaminated area, fish landings might not decrease at all, at least not in the year of the spill.

For the southern Pacific Coast states, attempts to quantify fishing losses from a hypothetical oil spill also can be extremely misleading because the great number of variables involved can produce drastically different results under varying circumstances. Nevertheless, a very rough estimate of the possible consequence of an assumed 100,000-barrel spill might be a 500-square-mile oil slick which, if occurring on southern California's most productive fishing blocks, might result in a reduction in fish catch. This presumes that no fish are taken for 60 days and that half the median number are captured during the next 60 days. A figure of $184,600, representing the loss to fishermen as a result of a spill, was based on the assumption that the catch in the affected area consisted of mackerels, anchovies and sardines. In comparison, the dollar value of the 1974 Los Angeles/Long Beach catch was $79,142,193.

The relative importance of each species is based on the number of pounds of each species landed at San Pedro during 1972. Value is assumed to be $115 per ton for mackerel and $35 per ton for anchovies and sardines. The figure of $184,000 is an extremely conservative estimate because (1) some of the mackerel would be sold as live fish and not reduced or canned, thus averaging a much higher price, and (2) many fish, more valuable than anchovies, mackerels, and sardines, would also be landed. It should be pointed out that if fishing efforts were concentrated elsewhere, outside the contaminated area, fish landings might not decrease at all.

Long-term deleterious effects could also result from an oil spill. There are four particularly important ones, impossible to quantify: (1) If large amounts of plankton were destroyed, the food web could be seriously disrupted and result in population crashes of organisms directly or indirectly dependent upon the plankton; (2) classes of juvenile or larval fish might be destroyed for an entire year, resulting in greatly reduced yields several years after the spill; (3) oil pollution might lower organisms' resistance to disease and other environmental stresses. This could produce less robust, lighter-weight individuals and an increased mortality rate over a long period of time, causing a slow, but marked decline in fishing; and (4) fish might have to be discarded due to tainting of the flesh.

One example was given by Connel (1971) who stated that the Australian mullet had a kerosene-like tainting due to the presence of kerosene-like hydrocarbons in the flesh. He found the contaminated compounds to be similar to substances isolated from river sediments. The river used by the mullet flows alongside oil refineries and associated storage and wharf facilities. Volatile hydrocarbons were found in the water adjacent to petroleum-storage facilities and also in the river's estuary near a sewage fallout. In addition, Clark (1973) cited the work of Shipton, Lost, Murray and Dale (1970) and Vale, Sidhu, Montgomery and Johnson (1970) concerning the same subject of kerosene-like tainted Australian mullets. Shipton, through gas chromatography and spectral analysis, reported the isolated kerosene appeared to be similar to a commercial sample of kerosene. Liver examination by optical and electron microscopes revealed higher amounts of free fat than in untainted samples (Vale et al., 1970).

This condition in higher animals can be caused by petroleum distillates (British use the term benzene [Browning, 1953]). Sea trout and plaice were found by taste test to be tainted. These fish were caught after the Torrey Canyon incident involving the spillage of Kuwait crude oil. No chemical analysis by chemical class was reported (Clark, 1973). If the spill were to occur in shallow, pristine areas, long-term fishing losses would almost certainly be incurred. Heavy wave action would mix oil down through the water column and over reefs, killing and injuring large numbers of invertebrates and algae. Therefore, small quantities of oil which might be tolerated by mainland coast organisms might destroy the same species in an offshore area.

Numerous studies on the effects of oil on commercially important shellfish indicate that these invertebrates may absorb hydrocarbons. To varying extents, they may be able to clean themselves of such contamination.

Oysters, Crassostrea virginica, may accumulate oil through feeding activity in a pollution zone. As the oyster feeds, it pumps water over a series of gill filaments which trap food particles such as phytoplankton. Hydrocarbons in the plankton may be incorporated in the oyster. Erdhart (1972) has found that oysters taken near the entrance to the Houston ship channel in Galveston Bay, Texas, are contaminated with a high content of petroleum-derived hydrocarbons. Because aromatic hydrocarbons are more soluble than paraffinic and naphthene hydrocarbons, the oysters most likely take up the aromatic fraction as a water solution through their gills, and as filter feeders, by accumulation of particulate food matter. The author found the composition of oyster contaminants to be similar to many Texas crude oils, among them Conroe crude, Beaver Lodge crude, and Lee Harrison crude.

Results from Blumer's (1972) study on more highly aromatic No. 2 fuel oil suggest that oil becomes part of the organism's lipid (fatty) pool. Blumer noted that the oil in specimens observed from a Massachusetts oil spill remained relatively unchanged in composition or quantity. He reasoned that if the oil were localized within the digestive tract, a shellfish could eliminate it rapidly. But if the hydrocarbon persists over a period of six months, its presence in adductor-muscle tissue, and the lack of further degradation of these hydrocarbons, indicated that it becomes part of the organism's lipid pool.

Anderson (1973) observed oysters, Crassostrea virginica, and clams, Rangia cuneata, exposed to South Louisiana crude oil and to No. 2 fuel oil, and came to a different conclusion. Anderson found that both aromatic and saturated hydrocarbons are released from the tissues more rapidly than did Blumer. Maintenance in clean water for periods of 24 to 52 days was reported sufficient to cleanse the tissues of detectable levels of hydrocarbons.

Teal and Stegeman (1973) measured the amount of hydrocarbons remaining in contaminated oysters after their return to clean water and found that a concentration of 34 milligrams per gram net weight persisted in a stable compartment. The authors concluded that, while the oysters would not retain nonbiogenic (petroleum) hydrocarbons permanently, complete purging would take a considerable amount of time.

Scarrat (1971) has found that commercial species of scallops ingested spilled Bunker C oil. Subsequent chemical analysis revealed the presence of Bunker C in the mantle, digestive gland, adductor muscle, and gonad.

Increasing evidence suggests that marine organisms have the ability to depurate accumulated petroleum hydrocarbons. This suggests that the classical food chain buildup does not occur. Naphthalenes remain within the prey species longest and are also among the most toxic petroleum fractions (Anderson, Neff and Petrocelli, 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes, and if benzo-a-pyrene reaches high enough concentrations in predators, death or possibly cancer can result. If the classical food chain buildup does not occur, the impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem.

Studies on the effects of petroleum hydrocarbons on shrimp are few. St. Amant (1973) referred to a concentration of oil of 1 percent as being lethal to these organisms. He added, however, that to reach this concentration under field conditions, more than 3,000 gallons of oil per acre-foot of water would be required to meet the concentration. This concentration is rarely acquired except in the immediate area of a spill.

Effects on shellfisheries of the southern California borderland due to oil operations have apparently been less well studied. Similar effects are expected to occur with local filter feeders, as reported above.

In summary, extreme caution should be taken against both short- and long-term deleterious effects on commercial fisheries. Oil spills may physically prevent fishing in contaminated areas for months. Adult finfish are not normally killed outright, but may suffer a long-term decline from lowered resistance to disease and environmental stress. Larval and juvenile fish can be killed in great numbers. Many fish not destroyed may be tainted with hydrocarbons and be unmarketable. Shellfish are more susceptible to contamination because of their inability to escape and their general filter feeding habits. Many larval and juvenile forms could be killed outright. Survivors could be tainted and unmarketable for long periods. Authors disagree on the time required for shellfish to cleanse themselves. Estimates vary from several months for complete depuration to six months with no depuration.

The containment of a major oil spill, and the removal of its visible and chemical effects from the human environment, can be a costly and time-consuming operation. Critical factors contributing to the total cost of an oil spill include: (1) the volume of oil spilled; (2) the area covered by pollutants; (3) the duration of the spill; (4) the intensity of oil concentrations on beach areas where it comes ashore; (5) the clean-up/containment measures involved; and (6) the actual costs of clean-up activities to the operator, governmental agencies, and other organizations involved in the containment effort. Considering the many physical, social, and economic factors which interact to determine the final dollar cost of an oil spill, an accurate estimate of total direct and indirect costs to society is only possible after the fact. The combination of interacting variables is unique to that particular spill and must be identified, and the results quantified. Hence, it is impossible to ascertain what the economic impacts would be if a SOHIO tanker accidentally spilled oil in those areas where an oil spill trajectory analysis was performed.

In view of the obvious difficulties inherent in attempting a detailed cost analysis of potential tanker-related oil spills, several researchers have estimated dollar costs to both the 1967 Torrey Canyon incident and the 1969 Santa Barbara Platform A blow-out.

The cost of the Torrey Canyon spill has been estimated at $34 million (Congress of the United States, Office of Technology Assessment, 1975). While the cost data derived are subject to fairly wide margins, it is important to note relative costs: 45.9 percent was for the cost of the hull, the cost of the cargo, and the salvage cost; 33 percent was the cost of clean-up and the cost of avoiding coastal pollution; the remaining 21 percent was the minimum estimate based on compensation claims.

Mead and Sorenson's estimate of the economic costs involved in the 1969 Platform A blowout will be used as an illustration of actual oil spill cost (Mead and Sorenson, 1970). According to them, the Platform A spill resulted in a total cost, measured in 1969 dollars, ranging from $16,415,850 to $16,439,850. On a percentage basis, the largest portion of the total cost (63.8 percent) was spent on cleaning up the estimated spill of 80,000 barrels and containing the blowout. Recreational value lost was the second leading category.

3.1.16.2 Long Beach area

Conversion/construction

In California there would be approximately 3,000 construction workers spread out over approximately 22 months of construction time. Slightly less than one-third of them will work on the marine terminal. In 1976 there were 107,000 construction workers employed in Los Angeles, Riverside, and San Bernardino counties; the workers employed by the proposed project would represent 1.8 percent of this total. In 1971 total personal income in this three-county area was approximately $55 billion (U.S. Water Resources Council, 1974); the construction salaries would be approximately $32 million, a very small portion of the regional total.

The terminal at Long Beach would take approximately 22 months to construct and represents the impact of greatest duration. This impact is not expected to have a major effect on the socioeconomic environment for the area since it is located in a region of intense development and activity near the Port. Personnel and payroll for the terminal are shown in Chapter 1, Section 1.2. A pump station would be constructed in this portion of the proposed route. Typical personnel requirements and payroll for a pump station are shown in Chapter 1.

In order to finance its portion of the proposed project, the Port of Long Beach would issue bonds totaling approximately $51 million. These bonds would initially be serviced at the rate of $3.825 million per year for the construction period and would then be retired for the next 27 years at an average annual debt service of $4.539 million including interest and principal retirement (Port of Long Beach, 1976).

This additional bonding would raise by 233 percent the present net bonded indebtedness of the Port. Annual debt service at $4.539 million would represent an increase of 133 percent in current bond servicing costs. The bond, however, would be secured by over $6 million in additional lease revenue.

During construction, revenues to local governments would average $2,382,000 per annum for three years. These revenues would result from property taxes on SOHIO-owned construction sites, sales tax subventions (one-sixth of the 6 percent sales tax is returned to local governments) on materials purchased for the project, some of the employee payroll spent locally, fees received for construction plan checking and building permits, and utilities taxes. The only significant cost to local government would be for relocating Fireboat Station No. 15 which is in the Port. When amortized, the annual cost would be about $34,200. Tax and other revenues to the City of Long Beach would greatly exceed this cost.

Once the facility is complete, annual revenues to local governments would rise to an estimated $7 million. These revenues include property taxes both on SOHIO-owned facilities and on the possessory interest attributable to the leased wharf and trestle built by the Port but leased by SOHIO. Additional revenues come from pipeline franchise taxes, sales tax subventions, and revenues paid to the Port for wharfage of bunkering vessels, as well as pilot service fees. The $7 million in revenue per year is a net receipt after bond payments and fireboat station amortization. Two and one-half million dollars will accrue to the City of Long Beach or special districts within Long Beach. This amounts to slightly more than 1 percent of the Long Beach total revenues for fiscal year 1976.

The Port of Long Beach would provide security in the form of Port income. The interest rate would be approximately 7.5 percent, given expected market conditions, and the payback period would be 30 years with interest only paid during the first three years during construction. Approximately $15 million would be in the form of serial bonds retiring at predesignated dates during the first 11 years of principal redemption. The remaining $36 million would be callable during the remaining 16-year payback period with a premium paid for early redemption.

Present bonded indebtedness of the Port is $47.7 million. However, $21.9 million would not begin to mature until 1981 and the proceeds are invested in Federal bonds due in 1980. Current budgeted debt service on all obligations is $3.4 million; the additional servicing on this bond represents a 133 percent increase. This $4.5 million is a 32 percent increase in the noncapital outlay expenses of the Port for the fiscal year 1975-1976. The yearly payment on the SOHIO Transportation Company lease would be $6.1 million, easily covering the debt service on the new bond.

Operation

Long-term operation and maintenance requirements indicate that the Long Beach terminal facilities would require 76 employees. It is probable that the long-term personnel would be available from the local labor force unless some specified job requires an unusual skill.

3.1.16.3 Pipeline route

This section examines the general effects of pipeline construction and conversion activities on the people and communities within the area traversed by the proposed pipeline project. Socioeconomic impacts are evaluated in terms of population changes, employment, and income. These general impacts are discussed on Federal, state, and local levels. Specific impacts in each state are also considered.

Construction/operation

Labor. Before a discussion of exact labor availability and unionized labor involvement can be finalized, the needs and requirements of the prime construction contractor must be known. At this time, selection of the prime contractor has not occurred. Therefore, only availability of the local labor force can be analyzed for impact, with assumptions pertaining to import labor.

As figures in the section entitled "Setting" in the socioeconomic impact analysis (Williams Brothers, 1976) indicate, there is an adequate supply of construction workers in all counties along the pipeline. Unemployment rates in all counties are such that construction workers would be available to participate in a project of this type. Therefore, lack of local labor is not expected. A reduction in the unemployment rate of construction workers in areas along the pipeline route could be a positive impact to those counties where the unemployment rate is high, but no new jobs would result.

Construction workers currently unemployed or about to complete another project would benefit from job opportunities provided by this project. This could result in short-term economic benefit for the construction workers during the pipeline construction, but the effect would be very limited.

If specialized laborers are needed and are not available in a particular area, they might be imported. Should this occur, the unemployment rate in a particular locale would be unaffected, since there would be no utilization of local skills.

Overall, if unionized labor members are used for all or parts of the pipeline construction, it could have more of an impact on labor availability in the right-to-work states of Arizona and Texas than in California or New Mexico, which have no right-to-work laws.

The basic assumptions of the Williams Brothers Environmental Impact Assessment (EIA) concerning the relative percentages of local and import labor required for the various portions of the project have also been assumed for this impact analysis, in the absence of any contrary information from the project's proponents, local labor officials, pipeline construction consultants contacted, and other sources.

These assumptions are:

1. Approximately 60 to 65 percent of the workers would be skilled imported labor from outside local areas of anticipated construction, except within California, where 100 percent of the total labor force is expected to be local (both skilled and unskilled) because of the unique nature of the southern California region and labor policies.

2. Outside California, approximately 35 to 40 percent of the workers, consisting primarily of unskilled laborers, would be drawn from the local area.

Housing. The availability of housing along the pipeline route for construction/operation needs does not pose a particular problem except where specifically indicated in individual impact sections. Midland/Odessa and the greater Los Angeles area would absorb the few transients associated with the pipeline project, and most of the necessary labor force for the terminal, line or pump-station construction would come directly from the surrounding regions.

The smaller cities or towns along the pipeline route have adequate transient housing facilities and are accustomed to large short-term influxes of transients. This results from either to a developed tourist trade or other construction projects that may have recently taken place in specific areas (Ecbo, Dean, Auslin, and Williams [EDAW], Inc., 1976). A short-term economic impact would be realized by the owners of those transient housing facilities during the construction phase all along the pipeline route, resulting in increased revenues.

It may be necessary to set up a construction camp for workers that are imported to an area where there is not adequate housing or service facilities within a one-hour driving time of the construction operation. A construction camp is the responsibililty of the prime contractor and it would provide food, shelter, and other supportive services for construction workers, as well as necessary equipment/materials storage.

Single or multifamily housing units may be required for nonlocal residents in areas where pipeline operations would be located. Field surveys indicate that in all cities where long-term operations would occur there is adequate housing available in all income/price categories for any new residents who might require housing (EDAW, Inc.,1976).

Retail services. Increased activity in the retail services during the short-term construction phase of the project may be realized by both retailers who supply goods and services to the construction worker and those businesses which supply materials for any construction or operation activities.

Goods and services required by the construction workers could include basic food, beverages, clothing, sundry items, and petroleum products, in addition to the housing needs previously discussed.

A short-term increase in retail sales activity might not occur in all areas. The employees from the local labor force who could work on the pipeline project are currently utilizing the retail outlets in their respective communities and only those imported workers would cause an increase in local retail activity during the construction phase.

For long-term impacts, the only increase in retail sales attributable to the pipeline project activities would be those purchases of goods and services made by new residents employed in the communities as a result of a pipeline operation or maintenance base.

An increase in retail sales, primarily petroleum products, could be realized by local businesses that would supply the contractor with needed material during the short-term construction phase or long-term operation of the pipeline and its related facilities.

Community services. If the need should arise, the services of fire, police, and medical support could be made available at any place along the pipeline route. Existing services throughout the study area are adequate to handle the influx of short-term transient construction workers. Field interviews indicated that additional support was available from Federal, state, county or other sources, if required, based upon the specific need/location. Federal support services are available because of the pipeline's proximity to national parks and government military installations.

Based upon these interviews, it is not expected that health, fire or police services would experience any significant impacts during the construction period, since these services would be required on a random and unpredictable basis, if at all.

Field interviews also disclosed that long-term operation of the pipeline in any of the given locations would not necessitate an increase, requiring new expenditure levels for existing community service functions. New construction or other changes would result in minor impacts.

Utilities. The existing utility infrastructure of the areas in which construction workers might choose to stay during pump-station, terminal or line construction is adequate to accommodate the short-term influx of pipeline employees and site-construction needs.

Electricity is the only utility required for long-term operation of the pump stations or terminals which would be affected by new transmission line construction at most pump stations.

According to field interviews (EDAW, Inc., 1976), companies providing electrical services to the pump stations have adequate capability to service these new needs of the project, as well as current and projected loads for the service areas within which the project is expected to occur.

Taxes. Although not quantifiable, additional taxes would be generated for states, counties, and cities throughout the entire route. Any purchases (lodging, food, and sundry items) made by the construction and operations personnel would result in an increase in state sales taxes for that particular state. (California has a 6 percent sales tax, while Arizona, New Mexico and Texas each receive 4 percent sales tax.)

It is not known where major purchases for pipeline construction and operation materials (such as heavy-duty construction equipment, lumber or concrete) would occur. Therefore, no projections of tax receipt "benefits" for any state or locality have been developed.

An increase in gasoline tax receipts would occur during the construction phase of the pipeline project. The increased tax receipts generated by the increased consumption of gasoline for the short-term construction period would benefit both the state and the county. Long-term operation of terminals and pump stations would also generate gas consumption, thereby increasing the gasoline tax receipts. However, this increase would not be as great as the short-term (construction-generated) increase in gasoline tax receipts.

Pending and retail sales taxes. A sample community along the proposed route is Casa Grande, Arizona, where there would be 93 construction workers in the area for about eight months. Some of these would come from outside the local employment area, either as part of the contractor's own labor force or as independent workers attracted by the prospect of employment. Others would be residents of Casa Grande, while some would commute from adjacent communities on a daily basis. Each would spend his income differently.

Table 3.1.16.3-1 shows the possible spending pattern based on type of worker:

Table 3.1.16.3-1

Anticipated Spending Pattern by Types of Labor in a Local Community

PURCHASES	Imported Labor	Local Labor	Commuting Labor
Lodging	Yes	No	No
Food	Yes	Yes	Some
Beverages	Yes	Yes	Some
Entertainment	Yes	Some	Some
Clothing	No	Yes	No
Personal care	Yes	Yes	No
Service station	Yes	Yes	Some
Garages	Yes	Yes	No

The imported labor would have the greatest new impact on local retail sales. The relative impact of local labor is uncertain. In the absence of the project, these persons might be working elsewhere or collecting unemployment benefits, thus allowing them to maintain their past spending patterns to some extent. Some commuting labor would spend money on food and drink, while others would supply their own. Most would obtain gasoline and service for their automobiles near their homes, except in emergencies or if more and better services were available near the job site as compared to their local community.

A highly conjectural estimate of the distribution of workers could be made and typical spending patterns assumed in order to develop a gross estimate of taxable sales, but there are so many variables that the exercise would be meaningless. Instead, a sensitivity analysis was performed and the results are shown in Table 3.1.16.3-2.

Table 3.1.16.3-2

Estimated Hypothetical Labor Work Force Expenditures and Retail Sales

CASE	Labor	Work Force	Percentage	Hourly Rate	Total Days	Workers' Total Expenditure
I	Imported	31	1/3	$15.00	120	$55,800.00
	Local	31	1/3	4.00	120	14,880.00
	Community	31	1/3	7.50	120	27,900.00
	Total expenditures					$98,580.00
	Total local sales tax @ 1% of expenditures					$985.80
II	Imported	62	2/3	$15.00	120	$111,600.00
	Local	31	1/3	4.00	120	14,880.00
	Total expenditures					$126,480.00
	Total local sales tax @ 1% of expenditures					$1,264.80
III	Imported	62	2/3	$20.00	120	$148,800.00
	Local	31	1/3	--[a]	120	-0-
	Community			10.00[b]		
	Total expenditures					$148,800.00
	Total local sales tax @ 1% of expenditures					$1,488.00

[a] No change directly related to project.

[b] No community labor; however, a person would earn $10.00/hour if applicable.

Table 3.1.16.3-2 (Continued)

Estimated Hypothetical Labor Work Force Expenditures and Retail Sales

CASE	Labor	Work force	Percentage	Hourly Rate	Total Days	Workers' Total Expenditures
IV	Imported	31	1/3	$20.00	120	$74,400.00
	Local	31	1/3	--[a]	120	-0-
	Community	31	1/3	10.00	120	37,200.00
	Total expenditures					$111,600.00
	Total local sales tax @ 1% of expenditures					$1,116.00
V	No distinction is made as to workers' location or distinct spending habits. The Williams Brothers EIA relates that total earnings per pump station exceed $262,000. If 20 percent is deducted to reach an estimated $210,000 in disposable income and 50 percent of this is spent on retail sales, which are taxable, a 1 percent tax would yield $1,050.					

Average income ($14,103) is equal for all. (In most cases, local income would be less since local workers would most likely be selected for unskilled tasks.) Construction force is 93 persons working five days per week for a six-month period. (Construction force would vary over the period which is eight months including start-up and clean-up time plus contingencies.)

All cases are reasonable hypothetical assumptions resulting in an average estimate of about $1,100 to $1,200 in sales tax impacts for the pump station construction. The estimates, however, do not include the possibility that some of the same crew would work on adjacent pump stations while living in Casa Grande.

Summary

It can be seen from the above five cases that sales tax resulting from the project would result in $985 to $1,500. In 1974, retail sales in Pinal County amounted to more than $182 million; county sales tax, 1 percent of sales, was $1,825,860. The impact of the proposed project is quite small. Using $1,500 in new taxes and the 1974 sales tax as a base, the project would provide less than .08 percent of the total.

The construction salaries from the terminal facilities to Ehrenberg amount to $32,000,000. If Kaiser Steel produces the steel pipe for the pipeline and steel plate for the storage tanks, its employees would earn more than $16,000,000 (Kaiser Steel, 1976). Using the multipliers developed by the Paradence Research Institute for the Los Angeles County Department of Regional Planning (Los Angeles, 1976), additional income generated by increased demand could be approximately $66,000,000. This represents a 38 percent increase in new income.

The construction in Arizona would be approximately $12,000,000. The multiplier effect could create additional income; however, the shortness of construction will tend to minimize this. Construction in New Mexico will amount to $7,000,000. It will generate little additional income. Construction in Texas will approach $15,000,000; since the major part of construction will take place in Midland, additional generated income could reach $1,000,000 or $2,000,000. This would be approximately 1 percent of total income in the Midland area.

The forging of steel pipe and plate will involve significant purchases from the following industry sectors: iron and ferro alloy ores mining, transferred imports, wholesale trade, coal mining, railroads, and miscellaneous business services.

The construction aspect will involve significant purchases from the basic steel products industry, the motor freight transport and warehousing industry, the petroleum refining industry, wholesale trade, and miscellaneous business services (U.S. Department of Commerce, 1974).

3.1.16.3.1 Pipeline route, urban segment, construction/operation

Los Angeles, San Bernardino and Riverside counties

Impacts that would occur as a result of construction of the proposed pipeline project west of Indio would be short-term minor impacts. (As defined by EDAW, Inc., the socioeconomic consultant, minor impact means a change in one or more socioeconomic factors that can be specifically identified or logically presumed, although not necessarily quantified, and which can be accommodated within the existing condition. Moderate impact means a change that would cause a strain on the area's capability to accommodate it. Major impact means a change causing irreversible and irretrievable changes in the existing/projected socioeconomic structure.) For the most part, construction of the pipeline follows existing rights-of-way and links with the existing Southern California Gas Company system, and the terminal construction would occur in developed industrial areas.

Long-term socioeconomic impacts, as a result of operation of the pipeline, would be minor since a small number of employees would be needed to operate the pipeline in Long Beach, an oil-related area.

The proposed construction area for the Long Beach Port and terminal is located in a developed industrial harbor. This area should not incur any socioeconomic impacts since it is already developed with oil-related projects that are similar in scope. Since this area has a previous history of oil construction projects, there could be a ready labor force to work on the proposed pipeline.

3.1.16.3.2 Pipeline route, nonurban segment, construction/operation

Redlands Pump Station

The Redlands Pump Station would necessitate a crew of 93 for construction. As with other sections of pipeline construction, the tri-county labor force is more than adequate to provide skilled and unskilled laborers for this short-term construction. It is possible that workers could come from the Redlands/Riverside or San Bernardino area. As a result, no significant impact would be realized by the local merchants from any short-term "new" money being spent in the community by imported workers. Those already in the community would continue with their present pattern of spending.

In summary, construction and operation of the pipeline and the related terminal and pump stations would result in minor impacts in western California (as defined by EDAW, Inc.)

Indio Pump Station

The Indio Pump Station would require 93 workers during the construction period of July, 1977 through January, 1987. The pump station is located approximately 10 miles east of Indio, California, adjacent to Interstate 10.

Impacts incurred as a result of construction of the Indio Pump Station would be minor since the community is capable of absorbing the short-term needs of the construction workers.

Desert Center Pump Station

Because Desert Center is a very small community, all workers would need to be imported for the short-term project. Indio, 52 miles to the west, and Blythe, 49 miles to the east, may both supply labor for the station (see Blythe and Indio profiles). The workers could use the limited services available in Desert Center, but would most likely return to their domicile for any major retail purchases, food or beverage needs. A short-term beneficial minor impact may be realized by the merchants in Desert Center during the short-term construction.

Desert Center to Ehrenberg construction and Blythe maintenance station

The short-term construction workers would probably be supplied with local labor from Blythe plus imported workers. Blythe, 36 miles east of the beginning of the new pipeline construction, is the nearest place with a supply of laborers plus any retail establishments or motels that imported workers would need. Impacts that would occur as a result of construction of the pipeline could be moderate and short-term if Blythe is used as a base of operation for both local and imported construction workers for this project. However, if the proposed pipeline is the only large construction project in Blythe, the impact would be minor and short-term.

The 1970 census for Blythe indicated that 130 workers, or 4.8 percent of the labor force, were in contract construction. However, a larger labor market is available, which includes incorporated Blythe, unincorporated Ripley, and the surrounding Palo Verde Valley. In 1970, labor market information for this area indicated that 227 workers were in construction, or 5.5 percent of the local labor force. With a project need for 425 workers, the local workers could contribute to less than half of this figure (assuming all were available for immediate work and that 1970 data were still appropriate in 1977). In any case, transient workers would be needed for the short-term pipeline construction. If these workers were to come from the larger metropolitan areas of Los Angeles, Riverside or San Bernardino, it would probably be necessary for them to live in the Blythe area due to the lengthy driving distances. The San Berndardino/Riverside area is approximately three and one-half hours from Blythe with the Los Angeles area another hour beyond that. It has been shown by the developed Interstate 10 business, that Blythe has adequate facilities to accommodate any influxes to the community. Further, with the agricultural business incurring seasonal peaks, a sudden influx of short-term workers in the area is annually anticipated, thus making the area capable of handling a construction project of this size.

Blythe would be the site of a long-term operation and maintenance station which would employ nine persons. These employees may come from the Blythe area and would not cause any significant long-term impact to the community. In summary, the impacts to this area would most likely be minor and short-term.

Ehrenberg Pump Station

The Ehrenberg Pump Station is located approximately 5 miles east of Ehrenberg, Arizona, and south of Interstate 10. It would employ 93 construction workers during a tentative construction period of May through December, 1977. Short-term impacts as a result of construction of the pump station would be minor since the local communities (Blythe, Ehrenberg, and Quartzsite) are capable of assimilating the construction workers and their needs for the construction period.

At present there are no motels in the area, therefore, any short-term imported construction workers not choosing to stay in Blythe would be limited to mobile living arrangements. (Apparently, a potential motel site is awaiting confirmation of Interstate 10 off-ramp location.) There are mobile home parks in both Ehrenberg and Quartzsite (14 miles to the east) with hookup spaces for transients with trailers, campers or mobile homes.

Livingston Pump Station

Quartzsite, Ehrenberg and Blythe are the nearest places to the Livingston Pump Station. There would be 93 construction workers at this site as well as at the other pump stations. These areas would realize a short-term impact since they can absorb the workers with little change to the present community structures during the short-term construction period. Since Blythe is considered a major staging area, it is possible that the construction workers would use that area as a home base if they are not from the local labor pool (see Blythe profile). Retail services are available in Ehrenberg and Quartzsite but on a more limited basis than at Blythe. Construction workers may expend some of their pay in the Ehrenberg-Quartzsite-Blythe area resulting in a short-term economic benefit for some businesses.

With construction occurring in the winter months, Quartzsite, where the population changes dramatically in the winter (see preceding discussion), may not be able to house the construction workers. If this is the case, the workers may choose to use Ehrenberg or Blythe as temporary living quarters. Depending on exactly where construction is taking place, the workers could be approximately 34 to 70 miles from Blythe-Ehrenberg. According to Williams Brothers (1976), a 50-mile driving range is the maximum daily driving distance for construction workers; thus, it may be necessary for the contractor to supply the workers with a construction camp that would provide housing, food, and a supply store for miscellaneous items. The relatively short construction period means that workers would commute a longer distance rather than set up a camp unless required by union regulations.

Gila Pump Station

The construction of the Gila Bend Station would result in minor short-term impacts to the communities of Phoenix and Gila Bend. There could be a moderate impact on transient housing in Buckeye. However, this could be easily mitigated by construction workers seeking transient housing in communities other than Buckeye.

Casa Grande Pump station

Because of its proximity and reasonable range of services, the city of Casa Grande would be the most likely source of the contractor's local labor needs, retail services, transient housing, and community services. Impacts to the community are considered minor since the community has the ability to absorb the construction workers during construction. A long-term minor impact would result from the maintenance of the station by 11 employees.

Construction workers who come into Casa Grande from other areas could utilize the existing transient lodging for the period of construction, resulting in a short-term beneficial impact to the owners of transient lodging.

Coolidge Pump Station

The long-term operation and maintenance of the Coolidge Pump Station would be coordinated from the Casa Grande maintenance station (see the Casa Grande profile). No personnel would operate out of the Coolidge Pump Station; therefore, there would be no long-term impacts.

The three primary economic functions of Coolidge and Florence are agriculture, services, and government. The retail trade sector together with service accounts for 50 percent of employment in Coolidge. Local merchants of retail outlets, grocery stores, and gas stations would benefit from a short-term economic impact with the influx of the construction workers, especially if many workers are from areas outside Coolidge and Florence. However, with the completion of the pump station, this economic gain would not be continued as the workers would leave the area for other pump station construction or other jobs.

Information for Pinal County indicated that in 1974 only 2.3 percent of the labor force was in contract construction. It is anticipated that for the year 1977, this figure would increase due to the construction of three pump stations in the county, plus a possible smelter and mine construction project by Continental Oil Company near the Coolidge-Florence area. The Continental Oil Company expects to have 1,720 construction and operation workers in 1977 (EDAW, Inc. conversation with officials in the Coolidge-Florence area, August, 1976). It is possible that with these two projects in the same area, there would be competition for specialized labor skills.

Local transient housing in Coolidge consists of four motels with 62 rooms. Florence has an additional two motels with 32 rooms. Construction workers coming into the area with campers or other mobile living arrangements can find some accommodations at local travel trailer parks, or mobile home parks with transient spaces. Owners of these transient housing facilities may therefore realize a short-term impact during construction.

Workers assigned to the Coolidge Pump Station would expend a portion of their salaries on goods and services in the Coolidge-Florence area, which in turn results in a short-term impact on Pinal County tax rolls. There would be a new generation in property taxes resulting from improvement of 5 acres to accommodate the Coolidge Pump Station. The Arizona property tax assessment schedule indicates that industrial property is assessed at 27 percent of the full cash value. No additional local taxes were found that would have an effect on the short-term or long-term operation of the pump station.

The capacity of existing utility infrastructure should be adequate to accommodate the short-term impact of the Coolidge Pump Station construction. Other construction projects of a slightly larger magnitude in the area during the past did not alter the existing utility system (EDAW, Inc., conversation with officials in the Coolidge-Florence area, August, 1976); therefore, it can be assumed that the proposed pipeline project would affect the present utilities to an even lesser degree, resulting in only a minor impact to Coolidge and Florence during the pump station construction.

Black Mountain Pump Station

Because of its proximity to Tucson, where services are readily available, there would be minor, short-term impacts on the Mammoth-Oracle-San Manuel area.

Redington Pump Station

Socioeconomic impacts as a result of construction of the pump station would be short-term and minor since the nearest community, Willcox, can accommodate the needs of the workers. Willcox has 13 motels with 251 rooms, for transients.

Cochise Pump Station

Socioeconomic impacts as a result of construction of the pump station would be short-term and minor since most of the workers would utilize facilities in Willcox or Bowie.

Lordsburg Pump Station

Because of the relatively large number of facilities in Lordsburg (23 gas stations, 11 motels with 370 rooms, 13 restaurants, department and supply stores), these services would not be significantly impacted during the short-term construction period since they currently experience high and low peaks from tourism and other construction.

For a copper smelting construction job, many workers drove from more than one and one-half hours away to work because there were not enough workers in the immediate area (interview with Don Rauch, Southwest New Mexico Council of Governments, August, 1976). The Lordsburg Pump Station would have nine long-term maintenance and operation personnel. If they are not from the local labor force, but are imported, they would most likely live in the vicinity of Lordsburg. There is available housing stock in Lordsburg now, and the employees would be absorbed into the community without causing any significant impacts.

Deming Pump Station

Deming could support any imported workers with little significant impact to the community. Construction workers from the copper smelter project south of Lordsburg have utilized some of the facilities of Deming, resulting in minor impact to the area (EDAW, Inc., interview; officials in Deming, New Mexico, August, 1976).

Anthony Pump Station

The socioeconomic impacts to El Paso, Las Cruces, and Anthony would be minor and short-term. Since pipeline construction activities would occur within one-hour driving time from the most probable place of residence (with the exception of the Guadalupe Pump Station), transient housing facilities would be minimally required; but, if needed, are available in El Paso.

Transient housing needs at the Anthony Pump Station could also be met with the facilities available in Las Cruces. The city has more than 1,200 hotel or motel rooms, available. In the greater Las Cruces area, there is an inventory of approximately 2,600 mobile home spaces which currently are 66 percent occupied (City of Las Cruces Planning Commission, 1976).

Most municipal services for the entire city are provided by Anthony, Texas. Medical services that are not available locally can be obtained in El Paso or Las Cruces (interview: West Texas Council of Governments, August, 1976).

Therefore, because of availabililty of all construction requirements, the economic impact to Anthony, and El Paso, Texas, and Las Cruces, New Mexico, would be minor and short-term.

El Paso Pump Station

As this pump station is within one-hour driving time from El Paso, no transient housing should be required. Should the need arise, more than 5,200 hotel and motel spaces are available, as well as spaces in mobile home parks.

El Paso also has sufficient fire, police, medical and recreational facilities to accommodate any additional personnel coming into the area during the construction or operation phase of the pipeline project.

The availability of water could be a problem if the pump station is located near the Hueco Tanks State Park. The water rights are held by the Texas State Park system, so clearance from the appropriate state agencies would be necessary if large quantities or long-term supplies were required (interview: West Texas Council of Governments, August, 1976). However, the water problems would be mitigated by the local contractor providing water trucks for the workers.

As stated before, the impacts on the El Paso area would be minor and short-term.

Guadalupe Pump Station

The pump station would be in a fairly isolated area. The nearest town is Salt Flat (approximately 18 miles from the pump station) which has a Federal Aviation Administration station and a building housing a bar, pool hall, general store and gas station.

About 30 miles to the northwest is Dell City, an incorporated town of 460 persons. Dell City has several retail outlets (two gas stations, a general store, laundromat, and hardware store). There is one 10-room motel and mobile homes scattered throughout the area.

Dell City has a volunteer fire department, and the National Park Service at Guadalupe National Park provides support services when necessary. A deputy sheriff is also located in Dell City.

There is also an existing pump station located at Guadalupe Peak operated by the El Paso Natural Gas Company. A permanent camp is located there which has houses and a school for the population of 150 employees and their families (interview at West Texas Council of Governments in El Paso, August, 1976).

With Carlsbad, New Mexico, more than one hour away, and the relative unavailablity of housing facilities near the construction site, a construction camp at the Guadalupe Pump Station could be required. Since construction would occur between December, 1977 and June, 1978, high winds, low temperatures, rain, and snow could make accessibility to the site a problem and hinder construction activities.

Although a construction camp could be utilized, the majority of laborers would probably commute from Carlsbad.

Housing is presently at a premium in Carlsbad. Apartments are being constructed as rapidly as possible to supply rental spaces for a new influx of persons to the area. This new influx of residents is due to increased construction activity in the area. Brantley Dam, being built to the north of Carlsbad, is in the second phase of construction. Money for the project has been appropriated by Congress, land has been purchased and is being surveyed, and an office for the project has been set up and staffed. Actual construction of the dam should begin within one year.

The Hospital Corporation of America is building a new hospital (approximately 150 beds) to replace the two existing small hospitals. Upon completion of this new facility, expected by the end of 1977, the two small hospital units would be converted to nursing homes or other medical facilities (interview: West Texas Council of Governments, El Paso).

There are several hotel/motel facilities which are 100 percent occupied during the tourist season and with the increased influx of construction personnel, 100 percent occupancy is expected to continue until apartment rental units are available.

Although food and sundry items could be obtained in Dell City, major purchases and recreation/entertainment could take place in Carlsbad or even in El Paso.

Since pump station construction workers would either commute from Carlsbad or live in a construction camp provided by the prime contractor, there would be no impact to the Guadalupe Pass area. The economic impacts would be minor and short-term in Carlsbad.

Pecos Pump Station

This pump station is located in a very isolated area near the Red Bluff Reservoir. During the summer months the area is filled with boating and skiing enthusiasts.

With the volume of construction activity occurring in Carlsbad and the availability of laborers there, the majority of the laborers needed for the Pecos Pump Station construction would come from Carlsbad (interview: West Texas Council of Governments, El Paso). Pecos, Texas, although more than an hour's drive from the pump station, could also supply construction workers. At present, construction projects in Pecos include a grocery store, football and track field, four school expansions, a kindergarten, a drug store, and a 60-bed hospital. The majority of these projects should be completed by January, 1978 (interview: West Texas Council of Governments, El Paso).

Although currently there is a housing shortage of all types in Carlsbad, by January, 1978 the local labor pool should have found suitable housing, thereby reducing the need for transient housing facilities. Should transient workers want to commute to Pecos, there are approximately 550 hotel or motel rooms available (interview: Pecos Chamber of Commerce, August, 1976).

Goods and services, as well as community services, would be utilized by the construction workers from the resources available in Carlsbad. Therefore, there would be no impact to the Pecos River area and only a minor short-term economic impact in Carlsbad and Orla.

3.1.16.4 Texas

3.1.16.4.1 Jal to Midland pipeline construction/operation

As previously stated, the availability of laborers needed for pipeline construction should pose no problem to this area because of oil-related activities occurring in the Permian Basin. The labor pools from Jal, Kermit, Odessa and Midland should be more than adequate for this phase of construction. Because of the availability of local labor, the need for transient workers should be almost nonexistent, minimizing the need for transient housing facilities.

If transient housing facilities are required, more than adequate hotel and motel units are available from Jal to Midland, all within one hour's driving time to construction sites (interview: Jal city officials and Midland Chamber of Commerce, 1976).

The dominance of the oil industry in the Permian Basin facilitates activities such as those connected with the proposed pipeline. Communities in the area are geared to handle the related project requirements. Therefore, the impact of this particular line construction project is considered minor.

3.1.16.4.2 Midland terminal construction/operation

The oil fields in the Permian Basin area produce almost 20 percent of the total oil production in the United States (Anonymous, 1975); therefore, a project such as the proposed pipeline is a relatively minor activity when viewed with this perspective.

The availability of laborers to construct the Midland terminal facility or to assist in the construction of the new pipeline from Jal to Midland should pose no problems. In December, 1975, the Midland/Odessa labor force had

4,480 persons working in the construction sector (Midland Chamber of Commerce, 1976). Labor unions are active, but Texas has a right-to-work law that is clearly in effect in the Midland area.

The local labor pool should be capable of supplying the needed workers for the terminal construction as well as those needed for long-term operations. If imported workers are required, current transient housing facilities appear adequate to accommodate them.

There should also be no additional requirements placed on available community services.

Because of the extent of the oil industry in the Midland area, the impacts during the construction phase would be short-term and minor. Impacts of terminal operations would be long-term and also minor.

3.1.16.5 Energy supply and demand

With a supply of 200,000 bbl/cd of North Slope crude oil in the Los Angeles Basin, it is hypothesized that the new supply of Alaskan crude would replace all of the Petroleum Allocation for Defense District (PADD) IV crude now being imported into Los Angeles as well as all African and South American crudes. It is expected that the new Standard Oil Company (California) refinery at El Segundo would use light Arabian crude when it goes onstream because it was designed specifically for processing this particular crude oil. It is also expected that the demand for low-sulfur fuel oil would continue to increase in the Los Angeles Basin because of air quality considerations, and that the importation of Indonesian sweet crude would continue.

Based upon such reasoning, the 1977 crude oil slate would be as shown in Table 3.1.16.5-1.

Table 3.1.16.5-1

1977 Crude Slate, Los Angeles Basin[a]

CRUDE SOURCE	Projected 1977 Crude Slate Without the Project	Projected 1977 Crude Slate With the Project	Change From Crude Slate Projected for 1977 With the Project
Mideast	228	140	-88
Indonesian	198	198	-
African	17	-[b]	-17
Venezuelan	13	-	-13
Other South American	54	-	-54
Four Corners	24	-	-24
California mix	614	610	-4
North Slope Alaskan	-	200	+200
	1,148	1,148	-
Lease condensate and isobutane	21.3	22.7	+1.4
	1,169.3	1,170.7	+1.4

Source: Robert Brown and Associates, 1976.

[a] Thousand barrels per calendar day (Mbbl/cd).

[b] Not applicable.

Liquid feedstocks for hydrogen production were the same for both cases, amounting to a total consumption of 797,000 bbl/cd. The above mix of crude would produce a composite crude oil in the Los Angeles Basin that is slightly less viscous and lower in sulfur content.

A comparison of the total product appears in Table 3.1.16.5-2.

Table 3.1.16.5-2

1977 Product Yields: Two Cases

PRODUCT	1977 With SOHIO Project		1977 Without SOHIO Project	
	Equivalent[a]	Percentage Total Feed	Equivalent[a]	Percentage Total Feed
Liquids	1,102.5	94.2	1,096.6	93.8
Gas (totally used as refinery fuel)	34.6	3.0	33.8	2.9
Coke	49.9	4.3	49.9	4.3
Sulfur[b]	971/1.4	-	1,002/1.5	-
Total	1,188.4	101.5	1,181.8	101.1

Source: Robert Brown and Associates, 1976.

[a] Thousand barrels per calendar day (Mbbl/cd).

[b] Long tons per calendar day or equivalent Mbbl/cd.

It has been estimated that the availability of onshore California crude by the year 2000 would be 325,000 bbl/cd and that these fields would be in decline by that time. In Section 2.2.16.5, the PADD V crude demand was estimated to be 2.637 million bbl/cd. By the year 2000, the crude slate is projected to be 1.157 million bbl/cd in the Los Angeles area (Table 3.1.16.5-3).

Table 3.1.16.5-3

Year 2000 Crude Slate, Remainder of PADD V and the Los Angeles Basin[a]

OIL SOURCE	Los Angeles Basin (Mbbl/cd)	Remainder of PADD V (Mbbl/cd)
California[b] (onshore)	237	88
Light Arabian[c]	151	151
Lube crude (So. Alaska)	-	100
Alaskan[d]	519	1,183
Offshore domestic[d]	205	466
Imports[e]	45	649
Totals	1,157	2,637

Source: Robert Brown and Associates, 1976.

[a] Based upon availability of 3.798 MMbbl/cd crude oil and shipment of 1 MMbbl/cd to Midland, Texas.

[b] Based upon historical split of 73 percent to Los Angeles Basin refineries.

[c] To Standard Oil of California facilities.

[d] Prorated on basis of capacity.

[e] Remainder: Assumed to be Mideast crude for the Los Angeles Basin refineries.

Table 3.1.16.5-3 shows that imports by the year 2000 would increase to both the Los Angeles area as well as PADD V.

There is little difference in the product yields in the year 2000 between a scenario with the project or without the project. This would not impact refinery processing units. With the availability of a supply of crude oil from the pipeline it is likely that importation of refined products from California into Arizona could be discontinued and replaced with products from new refinery facilities located in Tucson or Phoenix.

Natural gas

The proposed conversion of a 30-inch natural gas pipeline, owned by El Paso Natural Gas Company, and presently supplying part of the natural gas to southern California, would have virtually no impact on the gas supply/demand status on a present-environment basis. The transportation of gas through El Paso's system after the proposed natural gas line abandonment would however require increased main-line fuel consumption as a result of increased compression requirements in the smaller capacity system. Estimates based upon El Paso's projected sales for future years with and without the proposed abandonment show that the additional main-line fuel requirements would equal 8.74 billion cubic feet per year in the first year (1 percent of total throughput). This requirement will be less in future years as gas volumes in the Permian Basin continue to decline, thereby reducing natural gas transmission compression requirements. In the second year, natural gas requirements will be 7.22 billion cubic feet, the third year 5.94 billion cubic feet, and 5.19 billion cubic feet in the fourth year. By the nineteenth year, the requirement will be less than .5 billion cubic feet. Table 3.1.16.5-4 shows that existing supplies available to El Paso Natural Gas Company have fallen to a point that removal of the 30-inch line from service would not affect El Paso's ability to transport and deliver such gas supply volumes to the Southern California Gas Company System or other of El Paso's customers. Natural gas supplied from the combined El Paso and Transwestern pipeline throughput to Southern California Gas Company at Blythe, Topock, and Needles has dropped from original contract volumes of 2.5 billion cubic feet per day to an average of 2.1 billion cubic feet per day (cf/d) for 1975. Estimates for the 1976 supply average only 1.89 billion cf/d.

Most of the loss of available natural gas to customers will occur in California (82 percent or 7.15 billion cubic feet in the first year). While some Priority 3 users of natural gas would have to change to alternative sources because of the increased energy requirements for transmission, no economic impacts resulting from consumer conversion are expected.

Table 3.1.16.5-4

Total El Paso and Transwestern Excess Capacity Before and After Abandonment of One 30-Inch Pipeline for Transportation of Crude Oil

	Heating Seasons (Billions of cubic feet/day)				
SOURCES	1976-77	1977-78	1978-79	1979-80	1980-81
El Paso/Transwestern capacity out of the Permian Basin:					
with 30-inch pipeline	2.69	2.69	2.69	2.69	2.69
w/o 30- inch pipeline		.02[a]	.02	.02	.02
Total El Paso/Transwestern[b] supply from Permian Basin peak day	2.42	2.29	2.19	1.89	1.72
Surplus El Paso/Transwestern capacity out of Permian:					
with 30-inch pipeline	0.27	0.40	0.50	0.80	0.97
w/o 30-inch pipeline				0.13	0.30

Source: Robert Brown and Associates, 1976.

[a] Reflects a reduction in El Paso transport capability out of the Permian Basin of 0.669 billions of cubic feet/day assuming the abandonment of the 30" outside diameter gas pipeline in late 1977.

[b] El Paso Natural Gas Company, Exhibit 12 (AMD-11), Schedule 1, FPC Docket, reflecting presently dedicated supplies (1975 Form 15), plus deliverability from 220 billion cf/year, plus withdrawals from Rhodes Storage, less field fuel and shrinkage, unaccounted for gas, and field sales; Transwestern Pipeline Company supply to California from: 1975 FPC Form 15 Report, deliverability from 87 billions of cubic feet/day year reserve additions, 25 million cf/d transportation gas for Pacific Interstate Transmission Company, and gas supply from the Wesco coal gasification project beginning in late 1980.

The El Paso Natural Gas Company proposal to abandon a 30-inch line shows a continuing decline of Permian Basin source gas in the coming decade. Current environment and gas supply conditions leave little doubt that the line could be removed from service today with minor effect on the amount of gas available from El Paso for delivery to Southern California Edison Gas Company or other customers of El Paso. This is evidenced by the following factors:

1. On a straight throughput basis, the available El Paso/Transwestern supply in 1978 (2.32 billion cf/d) is less than the combined capacity of the El Paso Transwestern pipeline system (2.0 billion cf/d) after removal of the 30-inch pipeline as proposed. No short-term (2 to 3 years) change of significance is seen for supply other than a continuing downward trend.

2. If the FPC approves the abandonment of the El Paso 30-inch pipeline, and the supply continues downward as projected, the Southern California Gas Company internal transmission system would also have a surplus line available.

3. Southern California Edison Company and the Los Angeles Department of Water and Power have proposed to contract for as much as 0.4 billion cf/d of summer gas from the Permian Basin area. The Federal Power Commission (FPC) has dismissed the proposal until such time as a national policy is established on these issues. Under current load patterns, such volume, if approved, could be accommodated without the El Paso 30-inch line.

The immediate short-term effect on the Southern California Gas Company and other El Paso gas customers' gas supply and distribution apprears to be one of no impact as maintained by SOHIO and El Paso Natural Gas. This matter is under consideration in FPC hearings now in progress. Future supply possibilities must be examined to determine the impacts of new sources.

The SOHIO Environmental Impact Assessment prepared by Williams Brothers Engineering Company, and El Paso Natural Gas Company's related application to FPC for abandonment of the 30-inch gas pipeline state that the pipeline abandonment would have no impact on El Paso's capability to deliver all reasonably forecast gas supplies to Southern California Edison Gas Company and other customers served by El Paso Interstate Transmission System.

Under the following five scenarios, El Paso's statement would appear valid:

1. Permian Basin reliance. Continued reliance on the Permian Basin as a source of natural gas is expected. Heavy reliance on this source alone is not enough to satisfy southern California's basic energy needs.

2. Arctic gas pipeline. It has been proposed that natural gas be piped from Prudhoe Bay through Canada to Pennsylvania and the West Coast; 447 million cubic feet of gas per day would be allocated to California.

3. Trans-Alaska Liquid Natural Gas (LNG). A proposal has been made to build a gas pipeline from Prudhoe Bay to a Port in the Gulf of Alaska, and at that point to condense the gas to LNG and transport it by tanker to southern California.

4. Indonesia LNG as a major source. A proposal has been made to import from Indonesia approximately 540 million cubic feet per day of LNG.

5. Arctic gas/Midwest alternate. A proposal has been made that is similar to the Arctic gas pipeline except that none of the North Slope gas would physically reach California; all of the gas would be transported to the Midwest and the East.

Under the alternate high volume conditions the Arctic gas/Midwest alternate scenario brought attention to a rather high (97 percent) load factor during the first year (1981) of pipeline abandonment and Arctic gas shipments. El

Paso has plans for other projects which may contribute to the southern California supply picture before 1985. Chief among these projects are the Algerian LNG (Algeria II) and El Paso Burnham Coal Gasification proposals which would add about 688 million cf/d of natural gas from the Permian Basin/San Juan Basin combined system heading west by 1983. Of this total, about 400 million cf/d would be directly in the Permian Basin main-line system (Algerian LNG) and 288 million cf/d would be in the San Juan Basin northern loop. The significance of the San Juan Basin load is the reduction in its capability to accept redirected supplies when the Permian Basin main line reaches capacity or suffers compressor difficulties.

Under the Arctic gas/Midwest scenario, a deficit in natural gas pipeline capacity does appear with the abandonment of an existing 30-inch Permian Basin line. Tables 3.1.16.5-5 and -6 display the load factor effect for likely and high-volume futures. Marginal load factors (97 percent) are projected for 1983 for both the most likely and high volume conditions. Overloads (104 percent) are anticipated under high volume and most likely conditions in the second year that Algerian LNG is available.

Table 3.1.16.5-5

El Paso Natural Gas Company

Most Likely Case

Permian Basin Main-line Capacity[a]

	Average Daily Send-Out (MMcf/d)					
YEAR	Permian Basin Sources[b]	North Slope Alaska Supplies Arctic Gas/Midwest	Algeria LNG Supplies[c]	Total	Pipeline Capacity w/o 30" line (MMcf/d)	Load Factor Percent of Capacity Utilized
1978	1,676	0	0	1,676	2,020.6	83
1979	1,505	0	0	1,505	2,020.6	74
1980	1,378	0	0	1,378	2,020.6	68
1981	1,265	447	0	1,712	2,020.6	85
1982	1,164	447	0	1,611	2,020.6	80
1983	1,097	447	308	1,852	2,020.6	92
1984	1,049	447	618	2,114	2,020.6	104

Sources: Federal Power Commission, 1976, and Robert Brown Associates, 1976.

[a] Without the 30-inch line (1976 to 1985); NO IMPACT scenario, with all sources; LIKELY case. There would be four lines still open.

[b] Reflects average of projected peak day volumes from presently dedicated sources (1975 Form 15), plus deliverability from 220 billion cf/year reserve additions, as contained in Exhibit 12 of El Paso Natural Gas Company's evidence at Docket No. CP75-362, and considers deductions for field fuel and shrinkage, gas lost or unaccounted, and field sales.

[c] Deliveries of 308.0 MMcf/d of 1983 reflect average daily volumes to El Paso Natural Gas Company based on first year buildup volumes assumed for the Algeria II Project. Full deliveries of 618 MMcf/d are anticipated by 1984.

Table 3.1.16.5-6

El Paso Natural Gas Company

High Volume Case

Permian Basin Main-line Capacity[a]

	Average Daily Send-Out (MMcf/d)					
YEAR	Permian Basin Sources[b]	North Slope Alaska Supplies Arctic Gas/Midwest	Algeria LNG Supplies[c]	Total	Pipeline Capacity w/o 30" line (MMcf/d)	Load Factor Percent of Capacity Utilized
1978	1,707	0	0	1,707	2,020.6	84
1979	1,535	0	0	1,535	2,020.6	76
1980	1,391	0	0	1,391	2,020.6	69
1981	1,273	447	0	1,720	2,020.6	85
1982	1,190	447	0	1,637	2,020.6	81
1983	1,104	447	308	1,859	2,020.6	92
1984	1,034	447	618	2,099	2,020.6	104

Sources: Federal Power Commission, 1976.

[a] Without the 30-inch line (1976 to 1985); NO IMPACT scenario, with all sources; HIGH VOLUME case. There would be four lines still open.

[b] Reflects average of projected peak day volumes from presently dedicated sources (1975 Form 15), plus future reserve additions assuming deregulation under FPC National Gas Survey, Case IV, as contained in Exhibit 48 of El Paso Natural Gas Company's evidence at Docket No. CP75-362, and considers deductions for field fuel and shrinkage, gas lost or unaccounted and field sales.

[c] Deliveries of 308.0 MMcf/d in 1983 reflect average daily volumes to El Paso Natural Gas Company based on first year buildup volumes assumed for the Algeria II Project. Full deliveries of 618 MMcf/d are anticipated by 1984.

3.1.17 Public safety and public health

Public safety

Police. The impact of the proposed project on the demand for police service will be of no consequence. Present levels of manpower and equipment of the Long Beach Police Department and Port security would be capable of handling the low projected workload connected with the proposed project. Private security forces would be employed by SOHIO for the construction and operation phases of the project. Noncriminal police matters, outside the SOHIO property, would be managed by Port security.

Fire service. The most significant impact of the proposed project to fire service would be the relocation of Fireboat Station No. 15. The benefits of such a move would be improved access and call response. No new impacts of notable significance would be expected after the relocation.

Sabotage or terrorism. There exists along any transmission line or pipeline the possibilities of sabotage or terrorism. Any impacts to the environment by willful acts of sabotage would be identical to an oil spill along the line and are covered in the preceding sections. The probability of such an event occurring is very small during the life of the project.

While there exists the possibility of sabotage along any transportation corridor, it is thought that the probability of this occurrence along the proposed SOHIO pipeline is very small. The operation and maintenance functions performed by the pipeline personnel would diminish the impacts to the environment. Maintenance personnel will patrol the line daily for leaks, and operators will monitor the pressure within the line. A drop in pressure would indicate a leak. Personnel would be dispatched to repair the pipe, and valves would be closed to minimize the size of the spill.

Accidents. The probability and severity of an accident is related to project design and operational plans. The applicant included safety features in the design of the tankers beyond those that are required by current U.S. Coast Guard regulations, but are less than the full set of features desired by the state of Alaska. See Appendix A1.1.1.1 for details. Locating the proposed terminal well out in Long Beach Harbor also has a bearing on the possible level of impact in case of fire or explosion.

Inert gas systems -- The principal safety feature relevant to preventing fire or explosion on tankers is inert gas systems. Their purpose is to keep the oxygen concentration in the cargo tanks below the point where flames can be sustained; any hydrocarbons present would constitute an "over-rich" mixture. The systems and their operational use are described in Appendix A.1.1.1.1. Seven out of 11 of the SOHIO tankers proposed for the project, representing 74 percent of the SOHIO deadweight tonnage, would be equipped with inert gas systems.

Potential for severe losses -- The most severe losses of material and lives could result from the explosion of a tanker at dockside in Long Beach or Valdez harbors. An explosive cloud of hydrocarbons could be released from tankers lacking inert gas systems at Long Beach under certain adverse meteorological conditions. Any tanker while loading at Valdez could be lost or involved in a severe fire during times when the atmosphere is stable and winds are very light. Such accidents have not been frequent because there is the additional requirement of a spark to ignite the explosive vapor cloud.

Long Beach Harbor -- An event analogous to the Sansinena tanker explosion on 17 December 1976 could happen at Pier J if mitigating measures (Chapter 4) were not enforced. The similar event would involve an 80,000 DWT SOHIO tanker, or non-SOHIO tanker lacking sufficient tanks dedicated exclusively to ballasting.

When an oil tanker discharges its oil, it rides high in the water and part of the propeller and rudder mechanism are often above water. To regain maneuverability and stability, tanks are filled with ocean water to lower the ship. In a nonsegregated-ballast tanker, the cargo tanks and the ballast tanks are one and the same. As water is pumped into an oil carrying tank, it causes the hydrocarbons in the tank to be displaced, in a manner similar to filling the gas tank of an automobile. Depending on how completely the tanks are filled, various amounts of hydrocarbons will be displaced to the atmosphere through open hatches on the ship's deck. This is called venting. The released hydrocarbon-rich vapors mix with air and, in the process of dilution, the mixture for a time will be flammable (Day, 1972). Under most atmospheric conditions flammability is short-lived and the chance of a spark igniting the cloud is extremely remote. Under conditions like those on the evening of the explosion aboard the Sansinena, the rate of dilution is very slow. The air that night was damp, heavy (very stable), and wind was slight to nonexistent.

To prevent flames on deck from entering cargo tanks and thus give rise to an explosion, flame-arresting devices are attached to the hatches.

It has often been assumed that purging in port would enhance safety. There is a risk that the process could result in a fire exterior to the ship. Inert gas systems when properly operated confine the hydrocarbon vapors and segregate them from oxygen. This is the safest procedure and also minimizes impacts on air quality.

Port Valdez Harbor -- The potential for severe losses at Valdez, Alaska, during loading of crude oil appears greater than for off-loading at Long Beach. Calm stable air is more frequent there (Section 2.1.1.1 and [BLM, 1976]); the hydrocarbon emission rates are approximately double the rate for ballasting small, nonsegregated tankers at Long Beach; and all tankers loading at Valdez will expel hydrocarbon vapors at high rates. See Appendix A1.1.1.1 for further details.

Potential severity -- In an explosion within a cargo tank, the force can be severe. In the case of the Sansinena, a 300-foot section of the ship was removed leaving the bow and stern above water. Windows as far as 2 miles away were broken; pieces of 12-inch pipe were blown 500 yards into buildings. The greater distance of the Pier J terminal from areas of heavy population density would enhance the safety of the facility relative to current facilities in Los Angeles Harbor. The major damage would most likely be confined to the oil terminal and any other ships in the vicinity.

The explosion of a tanker at Pier J raises the possibility of pieces of pipe or other metal being blown into one or more of the storage tanks. Oil (up to 615,000 barrels) could ignite and result in large volumes of flame and oily smoke and become a threat to other tanks. Or the oil could collect in the dike. Then there would be serious danger of fire until foam suppressants were applied; there would occur extensive evaporation of hydrocarbons; and serious air quality impacts (including threat to the health of susceptible persons) would result the next day from oxidant formed downwind. The amount of fuel oil or crude oil spilled at Pier J would depend on particulars of the accident. The degree to which an initial accident could spread to engulf other facilities would depend on many factors. It should be borne in mind that the more complex the accident scenario visualized, the lower the probability that the event would occur.

Socioeconomic costs -- A major oil spill, loss of a tanker, or terminal explosion would always involve losses in the millions of dollars. Some information on cost-benefit analysis of tanker safety features is included in Appendix A1.1.1.1.

Traffic -- Without contingency planning, there could be critical congestion in the port or inland terminal area in case of a major accident. There was severe clogging of arterials after the Sansinena explosion. During construction, there would be an increased probability of automobile accidents because of convergence of additional workers into the port area and into other areas in the project corridor.

Public health

Degradation of water quality from oil spilled along the pipeline route could affect public health through contamination of the freshwater supply. A spill in the ocean could contribute incrementally to degradation of the food supply.

A major spill or chronic undetected leak in the pipeline could degrade freshwater resources (Section 3.1.5.2.2). Effectiveness of the oil spill contingency plans cannot be ascertained prior to a possible accident. Harm could occur from drinking water that contains harmful chemicals at concentrations too dilute to be detected by taste or odor.

The amount of harm done to the marine ecosystem, and eventually to man, by spilled oil is not known. Some oil hydrocarbons would find their way into fatty tissues of certain marine organisms and, in some cases, could be biologically concentrated up the food chain to man. There is some evidence that among these harmful chemicals are carcinogenic substances, such as 3,4-benzopyrene (Carruthers, 1967; Graef and Wenter, 1968). It is not known whether the potential harm would be less or greater with approval of the proposed project.

Health care and emergency medical services. The proposed project would not generate unusual demands for these services. Present services would adequately cover the increase attributed to the construction and operation phases.

3.1.18 Human attitudes, values, and social well-being

Although scientific sampling has not been undertaken to assess attitudes and values which have been or could be affected by the proposal, some generalities can be made from public informational meetings, public hearings, written comments, and newspaper coverage on the proposed project. More specific information on the former three sources is presented in Chapter 9 of the FES.

In general, the proposal has attracted and is expected to attract limited public attention, concern, or controversy. Isolated impacts on public attitudes and values have possibly occurred in the San Luis Obispo, California, and Port Angeles, Washington, area where public opposition to an alternative port site has occurred. Impacts on human values and attitudes may have occurred and would continue to occur to a relatively small population of Long Beach residents who would be directly impacted by port development and the Dominguez Hills terminal construction or are concerned with the projects possible impacts on local air quality.

The project has confirmed and would continue to confirm attitudes and values for many Long Beach area residents who favor industrial development in the area. These attitudes and values appear to be particularly prevalent in organized labor groups and business groups.

The proposed pipeline through California, Arizona, New Mexico, and Texas would generally be compatible with most area residents' attitudes and values, and impacts are expected to be minimal. Should a serious accident occur resulting in a major oil spill, fire, loss of life or property, or other other major impact as discussed in various sections of Chapter 3, public attitudes and values could be impacted.

Some persons, especially those personally affected by such an accident could be expected to change formerly held attitudes or values regarding the project or related developments relative to their personal safety or living environment.

Based on analysis to date, it is expected that impacts on cultural and social well-being will be minimal. For the purposes of this document cultural and social well-being encompass such standard indicators as personal income, employment, family stability, educational achievement, and recreational opportunities.

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CHAPTER 4

MITIGATING MEASURES

4.0 INTRODUCTION AND METHODOLOGY FOR DETERMINING MITIGATING MEASURES

Mitigating measures are those measures to be taken during construction, operation, and maintenance which will either eliminate or significantly reduce any adverse environmental impacts caused by implementation of the proposed action. There are many standard pipeline construction procedures which are in themselves mitigating measures; they are designed to reduce or eliminate potential impacts to the environment. For instance, burying a pipeline will protect the pipeline from climatic effects and vandalism and will also prevent the line from influencing animal distributions. Other examples are sump recovery of oil drips around valves and pump stations; providing crossovers above open trenches to allow unhampered movements of people and animals; fencing aboveground facilities to protect them against vandalism; stream-bank stabilization to reduce or control erosion; avoidance of areas susceptible to landslides; seeding disturbed areas with grasses indigenous to the area; allowing certain areas to undergo natural revegetation; consideration of environmental factors in selecting pump station sites; and use of a cathodic protection system to supplement the pipe coating, thereby preventing external pipe corrosion.

Similarly, in ship construction and in standard operating procedures at sea, mitigating measures prevent or lessen adverse impacts along the Sea Leg.

The need for specific mitigating measures, in addition to those proposed by the applicant in their Environmental Impact Assessment (Williams Brothers, 1976) and those discussed as standard engineering practice, was determined by analysis of the potential impacts identified in Chapter 3. The route from Valdez, Alaska, to Long Beach, California, and from Long Beach to Midland, Texas, was analyzed in terms of sensitive or critical areas related to climate, major ecosystems, geology, soil, freshwater and salt water, air, vegetation, wildlife, cultural resources, visual resources, noise, land uses and use plans, recreation, transportation, utilities, and socioeconomics. Impacts, based on the sensitive or critical areas of concern, were then analyzed by the proposed project phases; i.e., conversion, construction, operation, maintenance, and possible abandonment of the system. The criteria for mitigating measures were then determined, based on individual feasibility, legal authority, and ability of responsible parties to ensure implementation of the measures prior to issuance of discretionary permits.

The applicant will be committed to all mitigating measures that were submitted in the original project application (Section 4.1). The applicant must also comply with all mitigating measures that responsible enforcement agencies have agreed to enforce (Section 4.2). The measures not committed to by either the applicant or the responsible agencies at the time of publication (Section 4.3) may be included in the permit stipulations prior to issuance of permits. The mitigating measures outlined in this chapter should not be construed to encompass all measures that will be required. Many agencies are working or will be working directly with the applicant on measures under their jurisdiction.

The applicant-committed measures listed in Section 4.1 were compiled from the applicant's proposal, from subsequent answers to questions requesting clarification of specific items, and from the applicant-proposed trade-off measures (SOHIO, 1977) submitted to the South Coast Air Quality Management District in southern California. Other measures are expected to be proposed to this district and to the Texas Air Control Board.

Where documentation of the applicant's mitigating proposals was not site-specific, or was vague in the detail of measures to be used in mitigating a real or potential hazard, the proposals were amplified and made site-specific when possible and redocumented in Sections 4.2 and 4.3 (committed and proposed measures). Additional measures not in the applicant's proposal but deemed necessary to mitigate environmentally offensive impacts or to minimize catastrophic effects of natural phenomena are also included in these sections.

Although the applicant's committed mitigating measures are listed under the dominant or most readily apparent impacted physical resource for convenience, certain overlapping and interrelationships of resources are recognized.

In some geographic areas there is multiagency responsibility for permitting construction and operation of pipeline systems. Consequently, the Federal, state, or local agency or agencies listed in Sections 4.2 and 4.3 and known to have, or believed to have, permit procedures were provided with each mitigating measure listed.

The mitigating measures and agencies listed as having responsibility for enforcement are not all-inclusive in relation to land ownership. In construction and operation of the system, measures proposed on some private lands would be committed only if accepted by the private land owner, and enforcement responsibility appeared in the terms of the right-of-way grant.

On analyzing the anticipated effectiveness of the following mitigating measures, the assumption is made that all actions necessary to carry out the measures will be within the most current state-of-the-art.

4.1 APPLICANT-COMMITTED MEASURES SUBSEQUENT TO FILING APPLICATIONS

4.1.1 Engineering

1. Saltwater ballast contaminated with oil will be pumped to water treatment facilities at Valdez where the oil will be separated and sent to crude oil tanks. The remaining water will be treated to produce an effluent that will comply with EPA standards.

Anticipated effectiveness: Protection of water quality and biota of Valdez harbor. Enforcement procedures are treated in the Environmental Statement for the Trans-Alaska Pipeline.

2. Tank cleaning sediments will be diverted to holding tanks in Port Valdez.

Anticipated effectiveness: Unknown. No effective monitoring is available.

3. SOHIO ships will burn 0.5 percent or less sulfur content bunker fuel for off-loading crude oil and while in port at Long Beach.

Anticipated effectiveness: Reduction of sulfur dioxide levels to the point where the California standard would seldom be exceeded due to proposed operations.

4. Purging in San Pedro Bay will take place only in emergency situations (see Appendix A1.1.1.1).

Anticipated effectiveness: According to the applicant, purging in port would involve either considerable effort or expenditure of fuel, and therefore would not be a routine occurrence. Purging, however, would not be detected without monitoring.

4.1.2 Geology

1. Detailed geotechnical investigations will be conducted in the vicinity of faults (active and/or suspected).

2. All structural facilities will be located outside the San Andreas and San Jacinto fault systems.

3. In the areas of geologic or soil hazards (as defined by engineering and geological studies) special design methods will be employed.

4. The pipe will cross seismic faults at angles that are between 70° and 90° where possible.

5. A remote control valve will be located on the upstream side and a check valve on the downstream side of the San Andreas fault zone.

6. Areas of potential landslides will be avoided or special precautions will be taken to help prevent pipe failure should a landslide occur.

Anticipated effectiveness: Implementation of measures 1 through 6 will provide as much protection of the pipeline against natural catastrophes, such as earthquakes and landslides, as is feasible through engineering design.

7. Where possible, bedrock excavation will be ripped with heavy equipment. When blasting is required, charges will be designed to confine the excavated material within the right-of-way.

Anticipated effectiveness: This measure will enhance on-site safety of the construction workers. Also, there will be less disturbance to any local citizenry and wildlife.

8. Blasted rock, if appropriate in size and composition, will be used as trench backfill, as aggregate, or as erosion control material.

Anticipated effectiveness: Using this excavated material will facilitate cleaning up the right-of-way and leave it in a more aesthetically pleasing condition.

4.1.3 Soil

1. The best available system will be used for detecting small subsurface oil leaks.

Anticipated effectiveness: Assuming the best state-of-the-art detection system is used, small oil leaks should be detected in most cases before serious environmental damage occurs, although small leaks can present detection problems. Detection time is dependent on the size of the hole in the pipe, topography, and soil composition.

4.1.4 Water

1. The applicant will prepare an oil spill contingency plan for the marine terminal at the Port of Long Beach and for the pipeline route to Midland, Texas, prior to permit issuance.

Anticipitated effectiveness: The plan will reduce reaction time by specifying the sequence in which necessary actions must take place and by whom, and defining the best technique for cleaning up a given spill, depending on location.

2. Water crossings will be made at periods of low flow or no flow.

Anticipated effectiveness: Siltation impacts on downstream biota will be reduced.

4.1.5 Air and noise

1. SOHIO tankers will be equipped to burn 0.5 percent or less sulfur content bunker fuel for off-loading crude oil in the Port of Long Beach.

Anticipated effectiveness: This measure would reduce sulfur dioxide emissions from tankers substantially since SOHIO tankers would represent approximately three-fourths of the tanker tonnage using the Long Beach terminal.

2. Appropriate noise suppression devices for pumps, vehicles, and construction equipment will be installed. All Federal and local noise standards and regulations will be followed.

Anticipated effectiveness: Unknown. Development of standards on enforcement procedures affecting ambient noise levels has recently been required at the local level. Most communities in the pipeline corridor now have a noise element in their general plan (Table 2.1.11.4-1).

The following are the applicant-proposed measures to trade off, on a more than one-for-one basis, the emissions expected from the project in the Los Angeles Air Shed. The following proposed measures were extracted from the applicant's trade-off presentation (SOHIO, 1977) to the South Coast Air Quality Management District (SCAQMD).

3. The proposed importation through Pier J of 200,000 barrels per day of Alaska crude oil for local use will back out an equal amount of imported oil that is currently introduced under conditions resulting in greater air pollution than would occur under the SOHIO proposal. There would be a 2,460 lbs/day reduction of hydrocarbon emissions, a 1,200 lbs/day reduction of sulfur oxides emissions, an 844 lbs/day reduction of nitrogen oxides, and a 306 lbs/day reduction of particulate emissions. These emission reductions would be over and above the proposed project's "highest operational mode realistically expected," which was determined by the applicant to be two 165,000 DWT tankers off-loading simultaneously, an event expected at most once a year.

Anticipated effectiveness: There would be a net reduction in emissions if back out of older tankers occurs. The exact emission levels from, and duration of, the back out of foreign crude oil have not yet been agreed upon between the applicant and the review agencies (AQMD, California Air Resources Board, and Federal Environmental Protection Agency). The South Coast Air Quality Management District (SCAQMD) has indicated that it will, at most, accept oil delivered in SOHIO 120,000 and 165,000 DWT tankers as mitigating back out (SCAQMD, 1977[a]). The district has indicated that emission reductions may occur with or without approval of the proposed project, and perhaps prior to completion of the Pier J terminal (SCAQMD, 1977[b]).

4. The applicant proposes to reduce hydrocarbon emissions at three dry cleaners in the air shed by modifying the process and installing additional air pollution control equipment on existing

processes. There would be a net hydrocarbon emission reduction of 1,780 lbs/day.

Anticipated effectiveness: The exact level of emission credits will be negotiated with the review agencies.

5. The applicant proposes to install catalyzed ammonia injection on 33 natural-gas-fired internal combustion engines which drive compressors. The anticipated reduction in nitrogen oxides is 2,000 lbs/day.

Anticipated effectiveness: The exact level of emission credits will be negotiated with the agencies. Additional installations may be necessary.

6. Particulate emission reductions of 200 lbs/day would be obtained by paving streets, lots, or otherwise reducing fugitive particulate emissions.

Anticipated effectiveness: This trade-off seems inappropriate and does not lend itself to an assessment on a pound-for-pound basis. Fugitive dust consists principally of large silica-bearing particles which have lower capability of serving as nuclei for aerosol formation, lower impact on visibility reduction, and lower impact on human health than the particulate emissions expected from the proposed project. The ScAQMD considers fugitive dust emissions too episodic for serving as a basis for mitigation (pers. comm., 1977).

4.1.6 Vegetation

1. Temporary-use access roads will be removed.

Anticipated effectiveness: Revegetation success, whether natural or by reseeding, is dependent upon annual rainfall. Generally, less than 8 inches of annual rainfall is not sufficient for successful reseeding, and natural revegetation is very slow.

2. Where required, double trenching in cultivated areas will be practiced.

Anticipated effectiveness: Where this action is employed, topsoil fertility will be maintained.

3. Construction through fire-hazardous areas (San Timoteo Canyon, San Gorgonio Pass) will be scheduled, where possible, during periods of low-fire hazard. Fire safety precautions will be strictly enforced.

Anticipated effectiveness: Maximum public safety as well as protection from wildfire is expected both for the environment and for the Endangered plant species, Nevins barberry.

4. For the restoration of the right-of-way, landlords, local ordinances, or general landscapes and topography may dictate that some disturbed areas be seeded with grasses and/or other plants endemic to the area.

Anticipated effectiveness: The success of reseeding grasslands is highly dependent upon annual rainfall. Precipitation of less than 8 inches is not adequate for successful reseeding, and 8 to 12 inches of precipitation is unreliable for reseeding success.

Annual rainfall of more than 12 inches is normally necessary for effective reseeding. Right-of-way locations where successful reseeding efforts can be undertaken include the grasslands in the Puente Hills and from Jal, New Mexico, to Midland, Texas. Contacting local agricultural and conservation agencies for assistance will increase the effectiveness of revegetation success.

4.1.7 Wildlife

1. New pipeline will be buried wherever possible to prevent influencing animal distribution.

Anticipated effectiveness: Although it is unlikely that animals would be unduly influenced by exposed pipe, buried pipe is more desirable.

2. Where deemed necessary, crossovers of open trenches will be furnished during construction, thus allowing unhampered movement of animals.

Anticipated effectiveness: It is highly unlikely that deer, for example, would utilize such crossovers. Most animals would merely avoid the construction area.

3. Utility companies will provide raptor perches on transmission line structures to protect raptors from electrocution.

Anticipated effectiveness: Utility companies have been very successful in the past few years in constructing power lines that have almost eliminated raptor electrocutions.

4. Pump stations and maintenance base sites will be selected to minimize impacts to environmentally sensitive areas, such as critical wildlife habitats.

Anticipated effectiveness: Within the constraints of engineering feasibility, this measure will reduce potential impacts on areas that have been identified as sensitive.

5. New construction across the Colorado and Pecos rivers will be conducted during low-flow periods.

Anticipated effectiveness: Construction during low-flow periods will prevent impacts to fish spawn from construction-related sedimentation.

4.1.8 Land uses

1. Existing roads will be utilized whenever possible in agricultural areas.

2. Existing rights-of-way will be utilized or paralleled where possible.

3. The Bowie and Oracle compressor stations will be removed and reclaimed if the project is implemented.

Anticipated effectiveness: Measures 1 through 3 will minimize adverse impacts on existing and future land uses of lands traversed by the pipeline.

4. Use of the rights-of-way will be made available if requested for trails and other recreational activities.

Anticipated effectiveness: This measure will only be implemented where a Federal, state, or local governmental agency is willing to assume management responsibility for such trails and recreational activities on any given portion of the pipeline right-of-way. Most rights-of-way across private lands would be easements not fee title rights. Unless public trail use rights were specifically acquired in the easements, the applicant would not have the legal right to commit the pipeline right-of-way to public trail use. However, in the future it would be easier and less expensive for a public agency to acquire public trail rights along existing rights-of-way than across unencumbered fee title lands.

4.1.9 Cultural resources

1. Cultural resource surveys will be conducted prior to construction of new pipeline, pump stations or any other ground-disturbing activities related to the project implementation. See Section 4.2.8 for detailed discussion.

Anticipated effectiveness: The surveys will assure that all feasible measures will be taken to eliminate or reduce needless loss or damage to archaeological, paleontological or historic resources.

4.1.10 Visual resources

1. The applicant states that pump station sites were selected in a manner which avoids areas regarded as environmentally sensitive, and that aboveground facilities would not be aesthetically displeasing.

Anticipated effectiveness: A number of adverse impacts on visual resources from pump station sites have been described in Section

3.1.10, and detailed mitigating measures for specific pump station sites are required.

2. Applicant proposes to landscape pump station locations.

Anticipated effectiveness: Since no details regarding landscaping have been supplied, and present knowledge is based on artist sketches of pump stations, the measure cannot be assumed to be of any effect in minimizing adverse impacts until detailed landscape plans are submitted.

3. To eliminate 10 miles of new power line in Coachella Valley, Indio Pump Station will tap the nearby Southern California Edison 230-kilowatt line. Landscaped berms will be utilized around the pump station and all valves, pipes, buildings, and fences will be painted with nonglossy desert colors to minimize the visual impact on the surrounding area (see Figure 4.2.3-1).

Anticipated effectiveness: The visual impact will be reduced from a visual contrast rating of more than 20 (high) to less than 10 (low), thereby meeting BLM Visual Resource Management standards for this area. (Figure 3.1.10.3-1 shows determination of visual contrast ratings and standards.) The Indio Pump Station is sited on private lands but the 10-mile power-line tap in the applicant's original proposal crosses BLM-administered lands.

Coolidge Pump Station power-line extension

1. No vegetative clearing of the new power-line extension right-of-way to Coolidge Pump Station will be necessary, thereby eliminating the visual impact of a cleared swath of desert woodland vegetation.

Anticipated effectiveness: The adverse visual impact of a power line crossing the Pinal Pioneer Parkway remains. The power line crosses private and state lands.

Redington Pump Station power-line extension

1. The power-line extension for Redington Pump Station will be routed to avoid skylining as much as possible, and no clearing of desert woodland vegetation within the new right-of-way will be permitted. This will minimize the impact on vegetation, scenic, and open-space values.

Anticipated effectiveness: Adverse impacts on visual resources are minimized. If the power-line extension to the Redington Pump Station crosses an isolated tract of National Resource Lands (BLM), the route will be analyzed in a separate Environmental Assessment Report to be prepared by the BLM Safford District.

Cochise Pump Station power-line extension

1. The existing power line in San Simon Valley servicing Bowie will be upgraded and a power-line extension from the Cochise Pump Station to Bowie will be constructed rather than constructing an all new power-line extension to the substation in Sulphur Springs Valley.

Anticipated effectiveness: This will reduce the length of the new right-of-way for the power line from 30 miles to 8 miles, thereby reducing the impact on vegetation, scenic, and open-space values. Any power line traversing National Resource Lands in this area will be analyzed in a separate Environmental Assessment Report to be prepared by the BLM Safford District.

Guadalupe Pump Station power-line extension

1. The adverse visual impact of the Guadalupe Pump Station power-line extension on the view from U.S. Highway 62/180 of the Guadalupe Mountains will be eliminated by relocating the power line south of U.S. 62/180.

Anticipated effectiveness: The applicant has modified his original proposal to eliminate the adverse visual impact of the Guadalupe Pump Station power-line extension on the outstanding view from U.S. 62/180 across the Salt Flats to the Guadalupe Mountains. The power line crosses private and state lands.

4.2 MEASURES REQUIRED BY FEDERAL, STATE, AND LOCAL AGENCIES AND OTHER ENTITIES

The following measures were developed as a result of an analysis of the proposal. They either were not specifically attributable to, or not sufficiently detailed by, the applicant. These measures were presented in draft form to the agencies with jurisdiction, listed under each measure, to determine if the agencies were legally and administratively capable of implementing a specific measure. An asterisk beside the name of the jurisdictional agency indicates the mitigating measure has been committed to by that agency.

4.2.1 Sea Leg

1. The U.S. Coast Guard is developing Traffic Separation Schemes for Alaska and southern California coastal waters that will be implemented as appropriate. A channel Vessel Traffic System is under construction and will prescribe behavior of vessels in the Prince William Sound approaches to Port Valdez. Notice of proposed rule-making was published in the Federal Register in February,

1977. Final regulations have been promised by mid-1977. The Southern California VTS is in an earlier design stage.

Anticipated effectiveness: These regulations will reduce the potential for accidental oil spills in the Valdez harbor area.

Agencies with jurisdiction:

U.S. Coast Guard
State of Alaska, Tanker Facility Safety Group (406)*

2. While navigating Prince William Sound and Port Valdez, tank vessels engaged in the marine transportation of crude oil, refined petroleum products, or their by-products will be equipped with: (1) Loran C Navigational System receivers and other position-location systems prescribed periodically by the Alaska Department of Environmental Conservation; (2) electronically controlled collision-avoidance systems where applicable to an appropriate vessel as prescribed by the Alaska Department of Environmental Conservation by regulation; and (3) two radars, of types prescribed by the Alaska Department of Environmental Conservation, in working order and operating (Chapter 266 State Law of Alaska 76, Section 30.20.020).

3. Tankers of 40,000 DWT or more and lacking the following three maneuverability and stopping features must be escorted by tugs with an aggregate shaft horsepower equivalent to 5 percent of the deadweight tons of that tank vessel while navigating Prince William Sound and Port Valdez, unless exempted by the Alaska Department of Environmental Conservation. These features are (1) lateral thrusters, (2) controllable pitch propellers or astern horsepower equal to 40 percent of rated horsepower, and (3) redundant boilers, an auxiliary propulsion source or other backup equipment that the Alaska Department of Environmental Conservation may require by

regulation to provide for vessel's safe operation if equipment fails (Chapter 266 State Law of Alaska 76, Section 30.20.030).

4. Tanker traffic in Prince William Sound and Port Valdez will comply with a comprehensive, uniform system of traffic regulations for operation of tank vessels engaged in transportation of crude oil in the navigable waters of the state (Alaska Senate Bill 406 Section 30.20.030). In Alaska, all operators of oil terminal facilities must obtain an annual certificate of risk avoidance issued by the Alaska Department of Environmental Conservation. Operators of tankers carrying crude oil must also obtain such a certificate if they meet any of the following criteria: (1) transport oil to or from an oil terminal facility onshore or offshore, in state lands or waters, or (2) transport oil through state waters. These operators must also submit proof of financial responsibility (Alaska Department of Environmental Conservation, Chapter 266, State Law of Alaska 76, Section 30.25.040).

5. In waters off Alaska the amount of financial responsibility required for each carrier will not be less than $20 million or an amount required under applicable Federal law or regulation. The amount of financial responsibility required for each facility may not be less than $1 million or an amount set by the Alaska Department of Environmental Conservation.

6. An unexplained discharge of crude oil within the state of Alaska's jurisdiction or in waters beyond the state's jurisdiction, that for any reason penetrates within state jurisdiction, will be removed by or at the discretion of the Alaska Department of Environmental Conservation (ADEC). Expenses involved in the removal of discharges, whether by the person causing the discharge, the person reporting it, or the ADEC itself through its agents,

will be paid solely from the Coastal Protection Fund established by law (Chapter 266 State Law of Alaska 76, Section 30.25.110).

7. A person discharging crude oil in Alaskan waters in a manner prohibited by Section 20 of Chapter 20 of the Alaska Bill 406 will immediately undertake to remove the discharge to the satisfaction of the Alaska Department of Environmental Conservation.

Anticipated effectiveness: The strict adherance and enforcement of measures 2 through 7 will help to ensure governmental protection of the Alaska coastline. These measures will become legally binding in Alaska on 1 July 1977.

Agencies with jurisdiction (measures 2 through 7):

Alaska Department of Environmental Conservation
U.S. Coast Guard
State of Alaska, Tanker and Facility Safety Group (406)*

8. Any salmon streams from which stock is depleted as a result of the adverse effects of an oil spill will be restocked. Restocking will not begin until it has been determined that the adverse effects of the oil spill have subsided.

Anticipated effectiveness: Restoration of sport and commercial salmon fisheries.

Agencies with jurisdiction:

Alaska Department of Fish and Game
U.S. Fish and Wildlife Service
Washington Department of Fish and Game
Oregon Department of Fish and Game
California Department of Fish and Game*

4.2.2 Port of Long Beach and terminal area

1. All ships using Pier J will be required to burn 0.5 percent or less sulfur content bunker fuel south of Point Mugu. Otherwise, the applicant will need to acquire equivalent SO_2 emissions tradeoffs.

Anticipated effectiveness: Probability of exceeding sulfur dioxide standards essentially eliminated.

2. Only tankers having segregated ballast will be permitted to utilize the proposed Pier J berthing facilities. Individual ships will need prior approval to ensure that they have ballast tankage dedicated to seawater in an amount sufficient for seaworthiness (approximately 35 percent of cargo capacity).

Anticipated effectiveness: This measure will eliminate the severe hydrocarbon and oxidant impacts resulting from ballasting older nonsegregated and partially segregated tankers. It would also reduce the amount of oil released to the ocean environment.

3. Only tankers having inert gas or equivalent systems will be permitted to use the proposed berthing facilities. Vapor scrubbing systems (e.g., using catalytic oxidation) that are equivalently effective could also be found acceptable.

Anticipated effectiveness: When correct operating procedures are followed (see Appendix A1.1.1.1 for inert gas systems), there would be insignificant hydrocarbon emissions from off-loading; this would also establish the lowest practical potential for explosive conditions. Measure 1 of Section 4.3.2, if committed, would guarantee enforcement of this measure. SOHIO is in the process of retrofitting their 80,000 DWT tankers Intrepid and Resolute with an inert gas system. This will be accomplished prior to their use in the Port of Long Beach. SOHIO also states that the other two ships of this class will either be retrofitted or not used at the Pier J terminal.

Agencies with jurisdiction (measures 1 through 3):

U.S. Environmental Protection Agency
U.S. Coast Guard
California Air Resources Board
South Coast Air Quality Management District*
City of Long Beach Harbor Department
Port of Long Beach*

4. Unloading operations shall be conducted in accordance with CFR Title 33 Part 154, 155, 156 and shall not begin until such time as the vessel or the terminal berth enclosure is fully boomed as a preventative measure against potential oil spills. A boom is also to be in place during bunkering operations and all internal transfer of oil or dirty ballast.

Anticipated effectiveness: Impacts to the marine environment within the Port of Long Beach from accidental operational spills, such as the failure of a loading arm, will be significantly reduced with this containment equipment. It is anticipated that about 130 barrels of oil per year will be accidently spilled during unloading operations (Table 3.1.5.1.2-6). When contained within a small area with booms, very little oil should avoid detection and subsequent cleanup.

Agency with jurisdiction:

Port of Long Beach*
U.S. Coast Guard
California Regional Water Quality Control Board, L.A. Region*

5. The liquefiable soils beneath the base of the rock dike will be removed and foundation soils inside the rock dikes will be

densified. Mud and liquefiable soils will be removed before constructing the breakwater. Subsurface soils inside the rock dikes on Pier J will be densified.

Anticipated effectiveness: This will guard against future potential settling of facility and possible rupture of tanks.

6. Public access to the shoreline fishing area on the southeast corner of Pier J, which is popular with minorities and retirees, will not be curtailed. This can be accomplished by ensuring that free public parking adequate for approximately 50 cars within 500 feet of this corner is provided and that the shoreline is not fenced off from public access. Public access to the trestle can be denied for safety and security reasons.

Anticipated effectiveness: Measure will ensure that no shoreline fishing opportunity is lost.

Agencies with jurisdiction (measures 5 and 6):

Port of Long Beach*
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service (Fish and Wildlife Coordination Act)
City of Long Beach Harbor Department

7. Trained inspectors from the South Coast Air Quality Management District (SCAQMD) will perform complete monitoring, from the ship's entering to its departure. This will include all off-loading of crude oil, refueling, and ballasting operations. The inspector must be present during off-loading, but may be assisted by automated electronics to cover all other activities related to safety, air pollution, and water pollution. The inspector will be required to record any unusual procedure or accident, especially if it involves a danger of fire, oil spill, or unusual air pollution. Specifically, the inspector will not allow the discharge of oil

until the inert gas system is operating properly on tankers so equipped. All records will be considered public documents.

Anticipated effectiveness: This measure will provide effective monitoring to preclude purging in port; to enhance safety; and, to assure acceptable available pollution levels. Electronic monitoring would provide additional protection against purging in coastal waters, as well as the reduction of spillage and other emission incidents.

8. An air pollution monitoring station will be established in the port area to aid in measuring ambient concentrations of air pollutants from the port and general area.

Anticipated effectiveness: The existing monitoring station in Long Beach is not downwind of emissions carried on prevailing winds influencing the port. This measure will supply missing base-line data and serve to confirm effectiveness of other mitigating measures as well as any lapses from other emission sources in the port area.

Agencies with jurisdiction (measures 7 and 8):

U.S. Environmental Protection Agency
U.S. Coast Guard
California Air Resources Board
South Coast Air Quality Management District*
Port of Long Beach*

9. A temporary barrier or other measures will be utilized to reduce as much as possible the noise levels north of pile-driver operation at Pier J.

Anticipated effectiveness: Noise impact from pile driving due south of the present fill will be mitigated near the Queen Mary and farther north. Noise impact near the beach farther east will not be mitigated.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
California Coastal Zone Conservation Commission
City of Long Beach, Harbor Department
California State Occupational Safety and Health Administration (OSHA) (as it applies to health and safety of construction workers only)*
Port of Long Beach*

10. An analysis of dredging techniques will be conducted and a technique should be prescribed which would minimize environmental impact.

Anticipated effectiveness: In general, the utilization of a clam shell dredge would probably create the most turbid water conditions. A hopper dredge creates turbidity, but the technique can be regulated or eliminated when turbidity becomes too severe. A technique generally employed by a hopper dredge is the utilization of an overflow system. This technique is employed to obtain an economic load of sediments within the holding compartments of the dredge for transportation to a disposal site. This technique also results in fine material being introduced into the water column. If turbidity becomes too severe, as determined by an agency such as the Regional Water Quality Control Board, the overflow process can possibly be reduced or terminated as a means of significantly controlling dispersion of fines. Such an action would result in greater costs owing to the increased number of trips necessary to carry dredged materials to the disposal site.

11. Dredging operations will be conducted during the time of year that will minimize the impact on the marine biota.

Anticipated effectiveness: According to the Allan Hancock Foundation (1976), dredging during the winter months probably would have a lesser impact on most fauna in the harbor because populations tend to be smaller at this time, temperatures are lower, and circulation is better.

12. A discharge pipeline will be used when constructing the breakwater. The pipeline will be placed immediately above the bottom to facilitate sedimentation of flocculated particles.

13. Coarse-grained sediments will be placed on top of finer materials to provide an armor against wave attack and to reduce any long-term turbidity increase from the diked area.

14. To mitigate permeability of the breakwater, the sand core must be raised to an elevation of at least +7 feet MLLW, or the breakwater must be sealed to that elevation. If the breakwater is not made impermeable, a permanent boom must be placed under the entire trestle to prevent oil from escaping.

Anticipated effectiveness (measures 12 through 14): These three measures will reduce impacts on the marine biota from breakwater construction by increasing the settling rate of suspended particles, thereby reducing any long-term turbidity. Also, the breakwater will be strengthened, and the possibility of oil seepage through the breakwater will be reduced if a spill were to occur.

Agencies with jurisdiction (measures 10 through 14):

U.S. Coast Guard
U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
California Solid Waste Management Control Board*
California Coastal Zone Conservation Commission
California Department of Fish and Game*
California Regional Water Quality Control Board, L.A. Region*
  (measures 10 through 13)
City of Long Beach, Harbor Department

4.2.3 Pipeline route -- California

Los Angeles Basin

1. In all sections from Pier J to Redlands, watering will be required during construction.

Anticipated effectiveness: This is a fully effective measure to minimize dust emissions, where enforced.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
California Occupational Safety and Health Administration* (Cal OSHA) (applies only to the health and safety of construction workers)
Los Angeles County Flood Control District
Los Angeles County Department of Public Facilities and Transportation
Los Angeles County Agricultural Commission
City of Long Beach, Engineering Dept., Env. Div.*
City of South Gate, Engineering Department*
City of Downey, Engineering Division*
City of Pico Rivera, Engineering Department*
Port of Long Beach*
City of Long Beach, Building Department*
City of Industry, Engineering Department
City of Pomona, Engineering Department
San Bernardino County Flood Control District*
City of Chino, Engineering Department
City of Rialto, Engineering Department
City of Colton, Engineering Department
City of Fontana, Engineering Department
City of San Bernardino, Engineering Department
City of Loma Linda, Engineering Department*
City of Redlands, Engineering Department
South Coast Air Quality Management District

2. All valve locations in the Los Angeles River, Rio Hondo, and San Jose Creek corridors will be screened with landscape planting and fencing to minimize visual impact on open-space values.

Anticipated effectiveness: Measure will effectively buffer and soften visual intrusion in open-space areas.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
Los Angeles County Flood Control District
Los Angeles County Department of Public Facilities and Transportation
City of Long Beach, Engineering Dept., Env. Div.*
City of South Gate*
City of Downey*
City of Pico Rivera*
City of Industry

3. Riparian sites in the San Gabriel River channel and San Jose Creek channel will be avoided to conserve wildlife habitat; however, the pipeline will cross the San Gabriel River via a buried crossing.

Anticipated effectiveness: Maintenance of aquatic wildlife habitat that is extremely limited in this area.

Agencies with jurisdictions:

U.S. Fish and Wildlife Service
California Department of Fish and Game*
California Regional Water Quality Control Board, L.A. Region*

4. The pipe will be buried at a sufficient depth to prevent its being exposed by scouring action during infrequent flood flows in the San Gabriel and Santa Ana rivers, and any other creek, channel, or watercourse traversed. Work undertaken in any creek, channel, or watercourse will not obstruct storm or floodwater flows, and adequate measures will be taken to preclude damages therefrom to any adjoining public or private properties.

Anticipated effectiveness: Assurance that extreme high flood flows will not cause soil erosion or breaking of pipe causing a major spill into drainages.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
U.S. Department of Transportation, Office of Pipeline Safety
U.S. Fish and Wildlife Service
California Department of Fish and Game*
Los Angeles County Flood Control District
San Bernardino County Flood Control District*
California Regional Water Quality Control Board, L.A. Region*

City of Pico Rivera and Whittier Narrows Dam

1. Realign pipeline through Streamland Park along park roads, doglegging around planned swimming pool, to minimize conflicts with recreation developments and landscaping.

2. Realign pipeline through Pico Rivera Golf Course to avoid greens, tees, and fairways to the extent practicable, thereby minimizing disruption of golf course play. Restore all landscaping to preconstruction status by use of sodding and mature woody specimens.

3. Provide for temporary vehicular access to Equestrian Area before trenching access road.

Anticipated effectiveness (measures 1 through 3): These measures will minimize disruption of recreational activities and ensure restoration after construction.

Agencies with jurisdiction (measures 1 through 3):

U.S. Army Corps of Engineers
City of Pico Rivera*
California Department of Fish and Game*

San Jacinto, Banning-Mission Creek, and San Andreas faults

1. Redlands Pump Station will be landscaped with a citrus grove strip along the highway to screen the facilities from view of the road and to minimize industrial intrusion on agricultural lands. The power-line extension will be rerouted utilizing existing power-line rights-of-way and stringing the line on existing poles if possible.

Anticipated effectiveness: Visual impact of a 2.7-mile power-line extension across rural lands and industrial intrusion on agricultural lands is minimized.

Agency with jurisdiction:

San Bernardino County
City of Redlands*

2. The Santa Ana River check valve will be moved approximately 1.6 miles east of the proposed site to the intersection of Waterman Avenue to protect the river from a potential pipeline rupture on the Claremont Fault.

Anticipated effectiveness: The Santa Ana River will be protected from a potential pipeline rupture at the Claremont Fault.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
San Bernardino County Flood Control District*

San Timoteo Canyon

1. The right-of-way through San Timoteo Canyon will be adjusted to minimize disruption to wildlife habitat and agricultural lands.

Anticipated effectiveness: Disruption will be minimized (or eliminated) on the agricultural productivity, sensitive stream areas, and Rare or Endangered plant or animal species as well as other wildlife in the area.

2. Construction in San Timoteo Canyon will be scheduled during periods of low fire potential, and strict fire precautions will be observed. Specific critical fire season dates and construction periods will be coordinated with the California Division of Forestry.

Anticipated effectiveness (measures 1 and 2): Maximum safety from wildfire to public life and property will be realized, as well as protection of a sensitive wildlife area, the Endangered plant, Nevins barberry, and the California-classified Rare Stephens kangaroo rat from destruction.

Agencies with jurisdiction:

California Department of Forestry (measures 1 and 2)*
California Department of Fish and Game (measure 1)*

California desert

1. The power-line extension serving the Desert Center Pump Station will tap the Southern California Edison 69-kv line 3 miles to the northeast instead of extending 12 miles to the north of the substation. Alternately, the power-line extension will extend 3 miles to the northeast and then parallel the existing Southern

California Edison 69-kv line to the substation. No clearing of desert vegetation within the right-of-way other than at pole sites will be permitted. Landscaped berms will be utilized around the pump station and all valves, pipe, buildings, and fences will be painted with nonglossy desert colors to minimize visual impact on the surrounding area (see Figure 4.2.3-1).

Anticipated effectiveness: The visual impact of the Desert Center Pump Station on Interstate 10 will be reduced from a visual contrast rating of more than 20 (high) to less than 10 (low). The new overhead utility corridor will be reduced from 12 miles to 3 miles. Reduction of the new power-line corridor and elimination of the clearing of the right-of-way will reduce the visual impact on scenic and open-space values and decrease any possible impacts on the desert lily from motorized recreationists. A separate Environmental Analysis Report describing impacts of this alternative power-line extension will be prepared by the BLM Riverside District.

Agencies with jurisdiction:

U.S. Bureau of Land Management*
Riverside County Planning Commission

2. Chuckwalla Valley Dune Thicket near Ford Dry Lake in Riverside County (T.7 S., R.20 E., in Sections 5, 6, 7, and 8) will be avoided by relocation of the center-line of the right-of-way because of its high wildlife values.

Anticipated effectiveness: The pipeline right-of-way will be routed more than 0.75 mile to the north of the thicket; therefore, the proposed project will not affect this unique wildlife area.

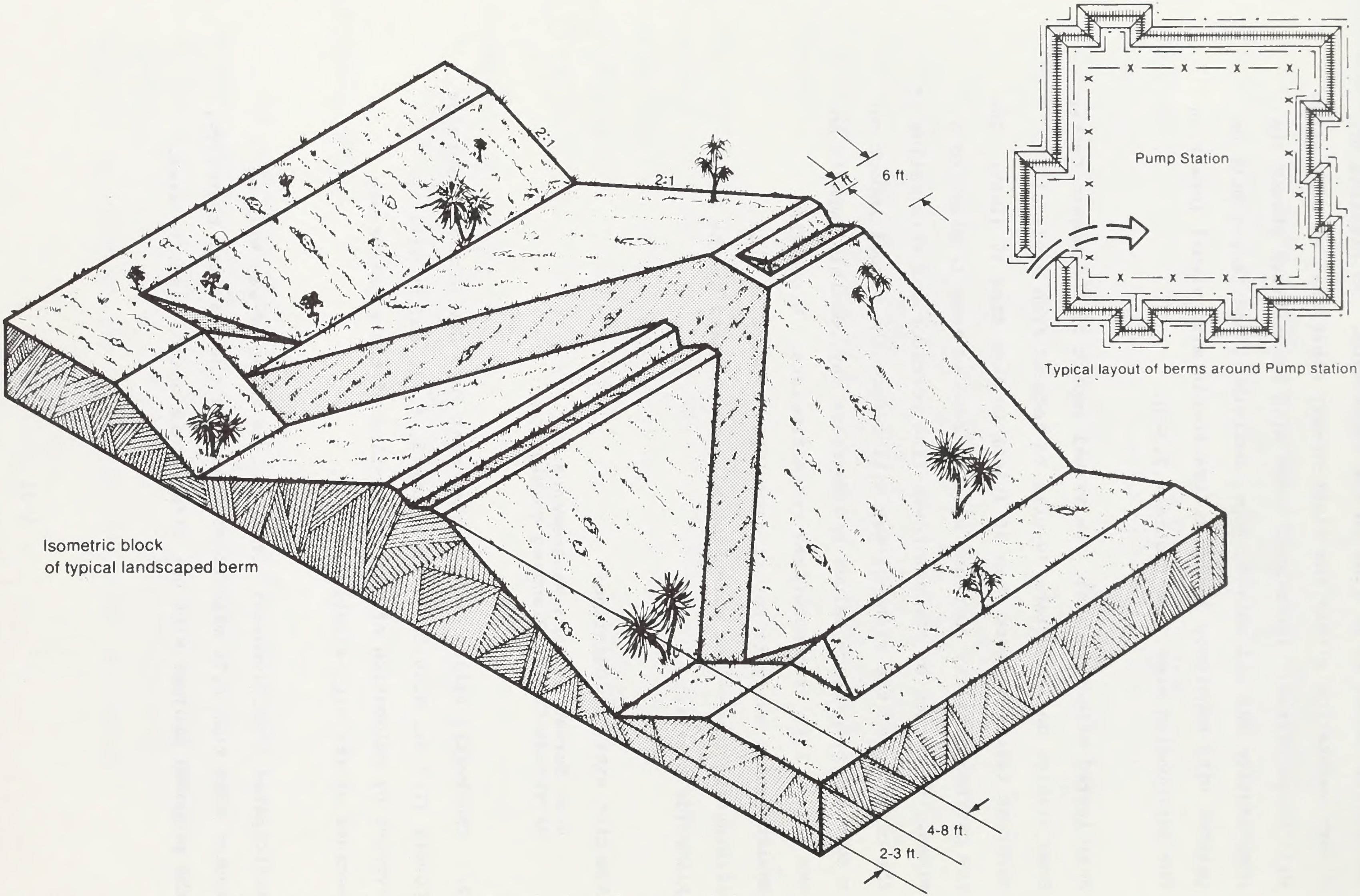
2:1
2:1
1 ft.
6 ft.
Pump Station
Typical layout of berms around Pump station
Isometric block
of typical landscaped berm
4-8 ft.
2-3 ft.

Figure 4.2.3-1 Sketch of typical landscaped berm

Agencies with jurisdiction:

U.S. Bureau of Land Management*
U.S. Fish and Wildlife Service
California Department of Fish and Game*
Riverside County Planning Commission

Colorado River

1. The pipeline will be designed so that pipe will be placed below the maximum anticipated scour depth.

Anticipated effectiveness: The likelihood that the stream bed substrate will wash out around the pipe, thereby increasing the possibility of a break because of support loss, will essentially be eliminated.

2. Pipeline construction will be conducted during low-flow periods in winter months (2,000 cfs or less).

Anticipated effectiveness: Siltation impacts on downstream biota will be reduced.

3. Streamside vegetation will be restored immediately after construction to prevent bank erosion. Indigenous riparian plant species will be used.

Anticipated effectiveness: Stream bank stabilization will be much more rapid than if allowed to revegetate naturally. Therefore, the problems of erosion and subsequent siltation will be reduced.

Agencies with jurisdiction (measures 1 through 3):

U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service*
U.S. Coast Guard
California Department of Fish and Game*

California Water Resources Control Board
California State Lands Commission*
Arizona Land Department
Arizona Game and Fish Department*
Palo Verde Irrigation District

4. Emergency oil spill contingency equipment will be permanently maintained on a site acceptable to the U.S. Fish and Wildlife Service. Also, an emergency off-stream storage basin that will accommodate the maximum possible oil spill will be constructed below the crossing.

Anticipated effectiveness: These measures will lessen the potential impact on the lower Colorado River by reducing oil spill reaction time and area that would be impacted, should there be a pipeline break at the river crossing.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Coast Guard
California Department of Fish and Game*
California Water Resources Control Board
California State Lands Commission*
Arizona Land Department
Arizona Game and Fish Department*
Palo Verde Irrigation District
Arizona Department of Health Services*

4.2.4 Pipeline route -- Arizona

Ehrenberg Pump Station and power-line extension

1. The Ehrenberg Pump Station site will be relocated approximately 0.75 mile east on the existing pipeline right-of-way to a point opposite the Interstate 10 interchange and the truck refueling stop. The purpose of this measure is to minimize visual and noise impacts on the roadside rest area. Landscaped berms will

be utilized around the pump station; all valves, buildings, and fences will be painted with nonglossy desert colors, to minimize the visual impact on the surrounding area. This mitigating measure will require construction of an additional 0.75 mile of the 42-inch pipeline in the Ehrenberg area within the existing pipeline scar (see Figure 4.2.4-1).

Anticipated effectiveness: The visual impact on the roadside area is reduced from a visual contrast rating of more than 20 (high) to less than 10 (low), thereby meeting BLM Visual Resource Management standards for this area.

Agency with jurisdiction:

U.S. Bureau of Land Management*

2. Alternatives to the proposed power-line extension over the Dome Rock Mountains will be studied to minimize impacts on desert bighorn sheep and scenic and open-space values. The first alternative would consider extension of the power line from the California side of the Colorado River following the existing distribution line serving Ehrenberg along a route no closer than 1 mile north of Interstate 10 to the Ehrenberg truck stop, crossing I-10 near the interchange and then extending to the pump station. A second alternative would follow an existing pipeline corridor north of the proposed pipeline corridor along Interstate 10 through the Dome Rock Mountains.

Anticipated effectiveness: The adverse impacts of a power line over the Dome Rock Mountains will be eliminated by either alternative. Impacts of the alternatives must be evaluated in a separate Environmental Analysis Report to be prepared by the Bureau of Land Management Yuma District before a decision regarding a power-line extension to the Ehrenberg Pump Station can be made.

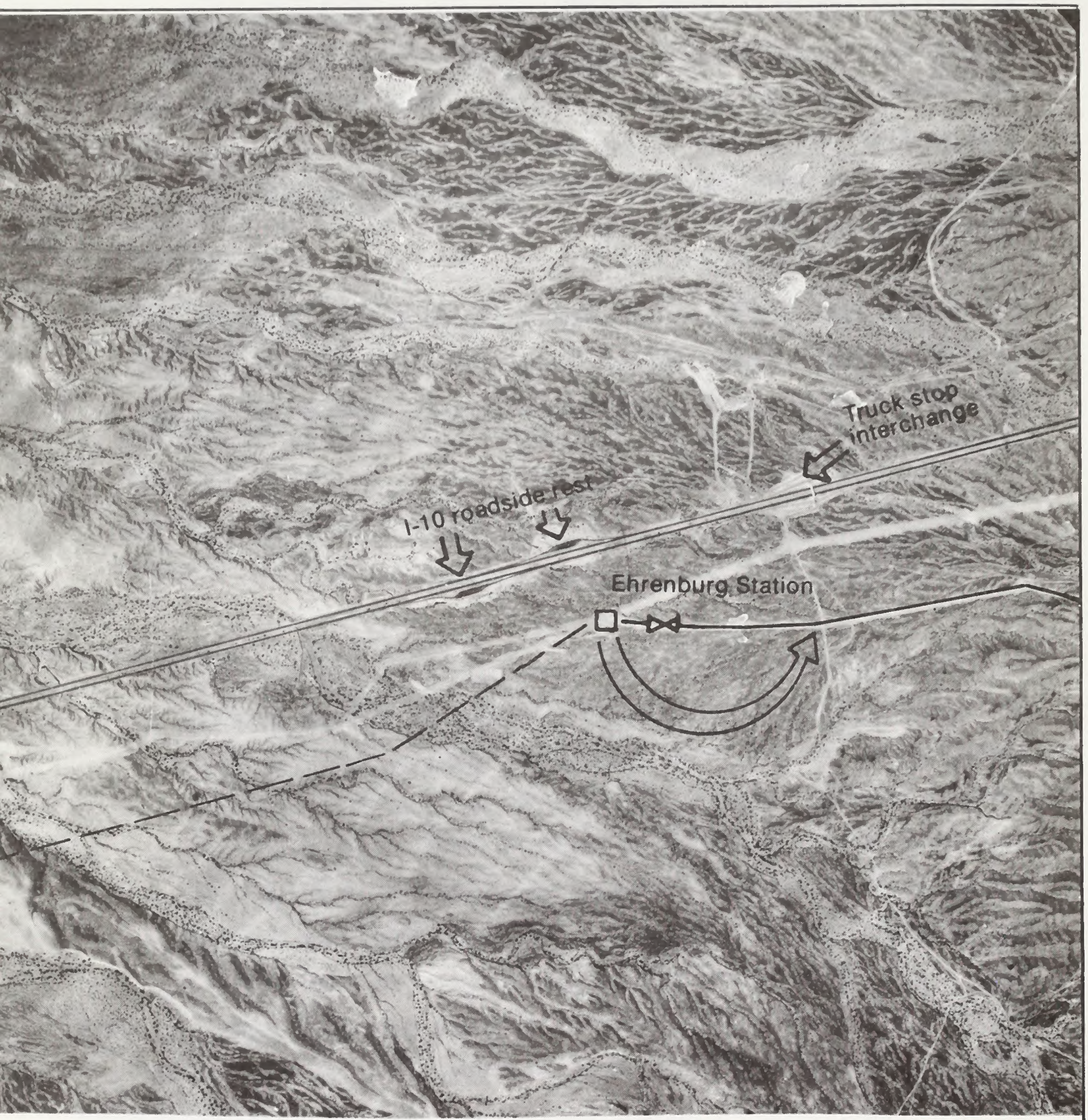

Figure 4.2.4-1 Proposed relocation of Ehrenburg Pump Station to minimize impacts on Interstate 10 roadside rest area

Agencies with jurisdiction:

U.S. Bureau of Land Management*
U.S. Fish and Wildlife Service*

Livingston Pump Station and power-line extension

1. The applicant will submit a detailed landscape plan of the pump station site showing all existing woody vegetation, saguaro cactus and contours, and proposed regrading and aboveground facilities. This landscape plan will minimize the disturbance to existing vegetation and must be approved by the BLM Yuma district manager. All vegetation deemed salvageable by the BLM Yuma district manager will be replanted; vegetation to remain will be fenced off from construction work. A buffer strip of undisturbed desert woodland at least 150 feet wide between the Livingston Pump Station and the Kofa Game Range access road will be left intact in order to minimize visual impact for campers and visitors to the Kofa Game Range. Landscaped berms will be utilized around the pump station. Pipes, valves, buildings, and fences will be painted with nonglossy desert colors to minimize the visual impact on the surrounding area so that campers and visitors to the Kofa Game Range will not be aware of this industrial intrusion.

2. The power-line extension will closely parallel the existing pipeline corridor and no separate maintenance road or additional clearing of vegetation except for pole sites will be permitted, to minimize the impact on visual and recreation resources. A supplemental Environmental Analysis Report will be prepared by the BLM Yuma District on this power-line extension.

Anticipated effectiveness (measures 1 and 2): This pump station cannot be moved any farther westward without adversely affecting pipeline hydraulics and total pipeline throughput. The pump station will be at least partially screened from the access road to the Kofa Game Range, thereby minimizing the adverse visual impact. The visual impact of the pump station as viewed from the access road is reduced from a visual contrast rating of more than 20 (high) to less than 10 (low), thereby meeting BLM Visual Resource Management standards for this area. The overhead power-line extension crossing of the Kofa Game Range access road will be eliminated.

3. The pump station will be relocated eastward to within one-quarter mile of the Kofa Game Range boundary to minimize its visibility from the Kofa Game Range access road to the Crystal Hills campground, subject to concurrence on the relocation by the U.S. Fish and Wildlife Service.

Anticipated effectiveness: Relocation of the Livingston Pump Station out of the Kofa Game Range to minimize wildlife impacts would place it immediately adjacent to the Kofa Game Range access road where it would be seen by visitors to the range. Relocation closer to the Kofa Game Range would remove the pump station visually from the access road.

Agency with jurisdiction (measures 1 through 3):

U.S. Bureau of Land Management*

Microwave sites

1. The microwave tower at the Ehrenberg Pump Station will be reduced in height from 250 to 60 feet. This can be accomplished by bouncing the signal from a passive reflector on Cunningham Peak (an established communications site) to Desert Center, rather than utilizing a 250-foot tower to bounce the signal off a passive reflector 5.5 miles southwest of Desert Center as originally proposed. The passive reflector on

Cunningham Peak will be placed by helicopter if extensive new road construction is necessary.

Anticipated effectiveness: The adverse visual impact of a 250-foot tower is eliminated.

2. The passive microwave reflector which serves the Livingston Pump Station on a spur of Middle Camp Mountain 2 miles northwest of the Dome Rock Interchange of Interstate 10 will be placed by helicopter to minimize impacts. The alternative of a passive reflector on Cunningham Peak, an established communications site, to serve the Livingston Pump Station will be studied in a separate Environmental Analysis Report to be prepared by the BLM Yuma District.

Anticipated effectiveness: Adverse impacts of access road and power line are eliminated by use of a helicopter-emplaced passive microwave reflector. The alternative of using Cunningham Mountain, an established communications site, would further minimize impacts but engineering has not yet established its feasibility.

Agency with jurisdiction (measures 1 and 2):

U.S. Bureau of Land Management*

Kofa Game Range

1. All exposed pipeline and valves, both existing and new, will be painted with nonglossy desert colors to minimize visual impacts.

2. The excavation of sand and gravel for pipeline construction will be limited to readily accessible predetermined washes as approved by the game range manager. This will reduce erosion and

visual impacts. Protection of streamside vegetation will be provided during sand and gravel excavations.

3. Surplus excavated materials within the right-of-way will be placed at predetermined and approved disposal areas to reduce visual impacts. Such areas will be designated by the game range manager.

4. After all lines are covered and soil compacted, any visible berm will be spread to contour to reduce visual impacts and to allow for natural revegetation.

5. The use of explosives will be limited to the period between June and October to minimize disruption of deer and sheep during the fawning and lambing periods and to minimize conflict with hunting seasons.

6. All construction activity will be kept within right-of-way limits except for the moving of equipment into and out of certain areas. This movement will be along established roadways. There will be no construction camps, and the only materials stored on the right-of-way will be pipe strung along the ditch line.

7. The pipeline right-of-way will not be bladed in its entirety, but only within that portion required for construction.

8. Pipeline crossings of ditches and washes will be buried below the flow line or protected by concrete deflection structures to prevent erosion.

Anticipated effectiveness: Measures 1 through 8 assure that every effort will be made to avoid any unnecessary disturbance within the Kofa Game Range boundaries.

Agency with jurisdiction (measures 1 through 8):

U.S. Fish and Wildlife Service*

Pipeline construction east of Kofa Game Range to Wenden Compressor Station

1. From the Kofa Game Range boundary, approximately 18 miles east to the Wenden Compressor Station, new pipeline construction will be restricted to the existing cleared right-of-way to minimize visual and vegetation impacts.

Anticipated effectiveness: Eliminates any impacts to land that has not been disturbed.

Agency with jurisdiction:

U.S. Bureau of Land Management*

Gila Pump Station and power-line extension

1. The use of landscaped berms around the pump station and the painting of valves, pipes, buildings, and fences with nonglossy desert colors will be required to minimize visual impacts on surrounding area.

2. The existing pipeline corridor will be closely paralleled by the power-line extension and no separate maintenance road or additional clearing of vegetation except for pole sites will be permitted to minimize visual and vegetation impacts.

Anticipated effectiveness (measures 1 and 2): The visual impact of the Gila Pump Station and power-line extension on the Arlington Wildlife Area and Gila Greenbelt will be reduced from a visual contrast rating of more than 20 (high) to less than 10 (low), thereby meeting BLM Visual Resource Management standards for this area.

Agencies with jurisdiction (measures 1 and 2):

U.S. Bureau of Land Management*
Maricopa County*

Gila River

1. Pipeline construction will be conducted during low-flow periods in winter months.

Anticipated effectiveness: Impacts on aquatic biota will be lessened. Also, interference with the primary nesting period for waterfowl and other birds will be avoided.

Agencies with jurisdiction:

U.S. Army Corps of Engineers
U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service*
Arizona Game and Fish Department*
U.S. Environmental Protection Agency
Arizona State Lands Commission

4.2.5 Pipeline route -- New Mexico

Lordsburg Pump Station power-line extension

1. Where the proposed power-line extension serving the Lordsburg Pump Station crosses National Resource Lands, there will be no clearing of vegetation within the right-of-way except for pole sites and possibly a maintenance road. Alternative alignments to the proposal will be analyzed in a separate Environmental Analysis Report to be prepared by the BLM Las Cruces District.

Anticipated effectiveness: Visual impact will be minimized.

Agency with jurisdiction:

U.S. Bureau of Land Management*

Pecos Pump Station and power-line extension

1. The power line serving the Pecos Pump Station will be rerouted to minimize skylining, and vegetation will not be cleared from the right-of-way. The use of landscaped berms around the pump station and the painting of valves, buildings, and fences with nonglossy colors will be required to minimize visual impact on the surrounding area.

Anticipated effectiveness: The visual impact of the Pecos Pump Station viewed from the banks overlooking the Pecos River will be reduced from a visual contrast rating of more than 20 (high) to less than 10 (low), thereby meeting BLM Visual Resource Management standards for this area. The power line rerouting will be covered in a separate Environmental Analysis Report to be prepared by the BLM Roswell District.

Agency with jurisdiction:

U.S. Bureau of Land Management*

Anthony Pump Station and power-line extension

1. The Threatened plant species Opuntia arenaria occurs on sand dunes at Anthony. The area will be surveyed for the Threatened species. If this species is found in the area, a biological opinion will be obtained from the U.S. Fish and Wildlife Service as to the sensitivity or critical nature of the site.

Anticipated effectiveness: This measure will assure the protection of this Threatened cactus species from any project-related impacts at the Anthony sand dunes.

Agencies with jurisdiction:

U.S. Fish and Wildlife Service*
Dona Ana County

4.2.6 Pipeline route -- Texas (including Midland)

Jal to Midland

1. If the final pipeline alignment should cross any prairie dog colonies larger than 10 acres, competent authorities will examine the area for ferret sign. If ferret sign is found, the prairie dog colony will be avoided.

Anticipated effectiveness: Avoidance of any habitat disruption of the Endangered black-footed ferret in accordance with the Endangered Species Act of 1973 will protect this species from further population losses.

Agencies with jurisdiction:

U.S. Bureau of Land Management*
U.S. Fish and Wildlife Service*
Texas Parks and Wildlife Department

2. The sand dunes in Winkler County will be surveyed for the Threatened plant, Proboscidea sabulosa, and efforts taken to protect the species encountered. If this species is found in the area, a biological opinion will be obtained from the U.S. Fish and Wildlife Service as to the sensitivity or critical nature of the site.

Anticipated effectiveness: The existence of this Threatened plant species will not be jeopardized by this project.

Agencies with jurisdiction:

U.S. Fish and Wildlife Service*
Winkler County*
Texas Parks and Wildlife Department

4.2.7 General

1. Chemical analysis of hydrostatic test water will be made to determine treatment needed, and disposal will conform to state or local discharge requirements.

Anticipated effectiveness: Maximum assurance test water will not contaminate a receiving soil, aquifer, water source, vegetation, or wildlife.

2. An oil spill contingency plan will be prepared by the applicant and approved by the Environmental Protection Agency and state authorities prior to operation.

Anticipated effectiveness: Maximum assurance for ocean, bay, and terrestrial oil spill cleanup.

Agencies with jurisdiction (measures 1 and 2):

U.S. Environmental Protection Agency
California Water Resources Control Board
California Department of Fish and Game*
California Regional Water Quality Control Board, L.A. Region*
Arizona Department of Health Services*
New Mexico Water Quality Control Commission
New Mexico Environmental Improvement Agency
Texas Department of Health
Texas Water Quality Control Board
California State Solid Waste Management Control Board*
Port of Long Beach*

3. Before issuance of a construction permit, a field search will be made for Endangered and Threatened plants and animals by personnel of the Bureau of Land Management or its agent after the center line right-of-way description and other site specific locations for pump station and ancillary roads are made available. If any Endangered or Threatened species are encountered in the field survey, a biological opinion will be obtained from the regional U.S. Fish and Wildlife Service office regarding the regulation of those species and their habitat. Also, a biological opinion will be obtained from the appropriate state fish and game departments regarding the regulation of state recognized Rare and Endangered species encountered during field survey.

Anticipated effectiveness: Maximum assurance that Endangered and Threatened species and their critical habitat will not be accidentally destroyed as a result of the project.

Agencies with jurisdiction:

U.S. Fish and Wildlife Service*
U.S. Bureau of Land Management*
California Department of Fish and Game*
Arizona Department of Game and Fish
New Mexico Department of Game and Fish
Texas Parks and Wildlife Department

4. Water diversion or containment levees and ditches will be restored to their original compaction and configuration following construction.

Anticipated effectiveness: This will maintain the present integrity and function of these structures.

5. Straight-line slopes in excess of 10 percent grade and a sustained length of 200 feet or more will be water-barred.

Anticipated effectiveness: Maximize slope stability to prevent accelerated soil erosion.

6. Rocks displaced during excavation will be spread on that portion of the right-of-way not needed for maintenance roads.

Anticipated effectiveness: The area will be visually enhanced.

7. All soil sites compacted by construction equipment and not required for subsequent surveillance or maintenance operations will be ripped to restore the soil to the approximate original bulk density.

Anticipated effectiveness: This measure will stabilize soils, prevent erosion, and provide a seedbed for revegetation.

8. Prior to construction in any area where revegetation will be necessary, the applicant will contact the local agricultural and conservation officials to obtain information on the best plant species and revegetation techniques to be used for that area.

Anticipated effectiveness: This will allow reclamation work to be based on more timely decisions, resulting in reduction of revegetation time and enhancing revegetation success.

Agencies with jurisdiction (measures 4 through 8):

U.S. Bureau of Land Management*
Various other land management agencies for public lands
County building inspectors for private lands

9. All remnants from construction will be removed and dumped at approved sites. Remnants include wood, metal scraps, containers, concrete truck cleanouts, gravel and sand piles, pieces of construction equipment, and small fluid (oil) spills.

Anticipated effectiveness: The construction area will be returned as closely as possible to the original condition by removal of construction debris.

Agencies with jurisdiction:

Land Management agencies (removal of debris from public lands)
County building inspectors (removal of debris from private lands)
Various county governments (approved dump sites)
Texas General Land Office*
California State Solid Waste Management Control Board*
U.S. Bureau of Land Management*

4.2.8 Cultural resources

The Bureau of Land Management recognizes its legal obligation to ensure that all Bureau projects and Bureau-assisted or licensed projects: (1) give adequate consideration to cultural resources, and (2) do not inadvertently harm or destroy cultural resources.

The primary authorities for the protection and mitigation of sites or areas which may be impacted are: (1) the 1906 Antiquities Act, (2) the 1966 National Historic Preservation Act, (3) the 1969 National Environmental Policy Act, (4) Executive Order 11593, (5) the 1974 Archaeological and Historic Preservation Act, and (6) 36 CFR 800.

It is the position of the Bureau of Land Management that if any portion of the SOHIO project is approved on the basis of this ES, and prior to initiation of a cultural resources plan, full compliance with guidelines developed pursuant to the above laws will be necessary.

The first step required is the identification of all sites or properties currently on or nominated to the National Register of Historic Places. This step has been completed and such properties are referenced in Chapter 2, Section 2.1.9.3.

In compliance with 36 Code of Federal Regulations (CFR) 800, and prior to any permit issuance, the applicant will concurrently conduct cultural resource overviews and an intensive (complete) survey of the proposed right-of-way and any supporting facilities where surface disturbance would occur (including, but not limited to, power-line extensions, pump stations, roads, and borrow areas).

In addition, a sample survey (10 percent level) will be conducted for a buffer of one-quarter mile on each side of the proposed right-of-way.

An archaeologist must also inspect the pipeline trench for subsurface archaeological sites concurrently with the trenching operation.

Archaeologists, historians, or paleontologists hired by the applicant for project work must be approved by the Bureau of Land Management and their work must be completed under an Antiquities Permit.

All cultural resources located along the proposed route will be evaluated by both the Bureau of Land Management and the appropriate State Historic Preservation Officer for National Register of Historic Places eligibility. Coordination must be maintained throughout the project between the Bureau of Land Management, the applicant, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, pursuant to 36 CFR 800.

The results of the field inventory will be submitted to the Bureau of Land Management (BLM) in acceptable report form. The report will detail findings of the inventory and make recommendations for further resource protection, either by avoidance or through mitigation studies. All sites will be evaluated for possible inclusion in the National Register of Historic Places.

Mitigation work may include all levels of research and field data collection, including surveying, photographing, collecting, recording, excavating, subsequent data analysis, and publication.

Upon completion of the survey and evaluation of all cultural resources, three options are available for legislative compliance (in consultation with the State Historic Preservation Officer, the Advisory Council, and the Bureau of Land Management): (1) avoid the identified resource; (2) mitigate impacts to the resource through a rigorous, comprehensive scientific study; or (3) a combination of the first two where feasible. Whenever possible, cultural resources will be avoided.

A protective buffer zone along any known historic trail segments (located within one-fourth mile either side of the right-of-way) will be established on the ground by the applicant and the representatives of appropriate state and Federal agencies. The Bureau of Land Management, State Historic Preservation Officer, and Advisory Council must be afforded an opportunity to comment on and approve the protection plan for sites and facilities within the limits of the project.

All identifiable historic roads and trails with visible remains of the road or trail should be crossed with a minimum area of disturbance, or should be avoided. This may require passing the pipeline underneath the road or trail without disturbing the surface on either side of the historic road or trail. In certain situations it may be deemed feasible to pass the pipeline beneath a cultural resource where avoidance or prudent scientific study appear unfeasible.

If the decision is to avoid resources, and site locations are known, the corridor center line, tower sites, access roads, pump stations, etc., must be relocated. Relocation of proposed facilities may also be deemed necessary to prevent indirect impact to sites located near the corridor.

This would protect against needless loss of nonrenewable resources as required by Federal legislation.

If mitigation is selected through scientific study, two categories may be considered: (1) that which must be accomplished prior to granting approval for pipeline construction, and (2) that which must be done in situations where the applicant may uncover subsurface cultural resources during development work.

The following detailed measures are designed to mitigate impacts upon cultural resources from the construction of the project. All specifications reflect requirements of existing Federal and state mandates and are required measures for all affected land, regardless of ownership.

1. Prior to construction on any part of the proposed right-of-way or related facilities where adverse impact to identified cultural resources is unavoidable, a full and complete mitigation effort must be implemented. The results of the mitigation work shall be reported to the Bureau of Land Management, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation.

2. The applicant will immediately bring to the attention of the BLM archaeologist all antiquities or other values of cultural or scientific interest discovered after completion of the inventory. Such discoveries will be left intact until clearance to proceed is granted by a BLM project archaeologist.

3. To facilitate better coordination of cultural resource mitigation during the construction phase, the applicant will (1) provide a project archaeologist to do on-the-ground monitoring of construction, (2) flag the perimeters of archaeological sites that are to be avoided, (3) promptly report pot hunters or vandals to

the liaison officer and project archaeologist, (4) require operators of vehicles or other equipment to operate only in specified areas which have been cleared for cultural resource values, and (5) inform all construction staff of their responsibilities from the standpoint of legal requirements for preserving cultural sites and artifacts.

Anticipated effectiveness (measures 1 through 3): Compliance with these requirements will assure that all practical measures will be taken to eliminate or reduce needless loss or damage to archaeological, paleontological, and historic values resulting from the proposed action. Special provisions should be made for implementing these measures when state or privately owned lands are involved.

Agencies with jurisdiction (measures 1 through 3):

California

Federal

U.S. Bureau of Land Management*

State

Department of Parks and Recreation, State Historic Preservation Officer

Arizona

Federal

U.S. Bureau of Land Management*

State

Arizona State Parks Board, State Historic Preservation Officer

New Mexico

Federal

U.S. Bureau of Land Management*

State

New Mexico State Planning Office, Cultural Properties Review Committee, State Historic Preservation Officer

Texas

Federal

U.S. National Park Service*

State

Texas State Historical Survey Committee,
State Historic Preservation Officer
Winkler County*

4.2.9 Endangered Species Act compliance

1. Section 7 of the Endangered Species Act of 1973 requires that Federal agencies shall take such necessary action as to ensure that actions authorized by the agencies do not jeopardize the existence of Endangered or Threatened species or result in the destruction or modification of critical habitat of such species.

Stipulations and permits issued prior to any new construction will require that the U.S. Fish and Wildlife Service and the appropriate state fish and game departments determine if any critical habitat will be impacted and recommend any mitigating measures necessary to comply with the Act.

Anticipated effectiveness: Maximum protection of plant and animal species whose existence has been determined by the Federal Government to be either Threatened or Endangered.

Agencies with jurisdiction:

U.S. Bureau of Land Management*
U.S. Fish and Wildlife Service*
California Fish and Game Department*
Arizona Game and Fish Department*
New Mexico Game and Fish Department
Texas Parks and Wildlife Department

4.3 PROPOSED MITIGATING MEASURES

The following mitigating measures, compiled by the SOHIO Project staff, have not been committed to by the applicant or by any responsible enforcement agencies at the time of this publication. Many of these measures will undoubtedly be committed to during the permitting process.

4.3.1 Port of Long Beach and terminal area

1. Landscape design should be provided by the applicant prior to permit approval to make the off-loading facility an enhancement of Pier J rather than a visual intrusion.

Anticipated effectiveness: With an adequate budget for landscaping and native plant materials, it should be possible to soften the visual impact of the applicant's proposal.

Agencies with jurisdiction:

California Coastal Zone Conservation Commission
City of Long Beach, Harbor Department

2. The number of storage tanks on Pier J should be reduced to the number needed to accommodate the surge of three 165,000 DWT tankers off-loading simultaneously with the 48-inch pipeline to Dominguez Hills pumping at capacity. Storage tanks constituting inventory will be removed from Pier J to the Dominguez Hills inland terminal site to minimize the magnitude of accidental spill or fire in Port and the visual impact on San Pedro Bay and Long Beach, (see Figure 4.3.1-1).

Anticipated effectiveness: Three of the six 615,000-barrel storage tanks can probably be moved inland but three 615,000-barrel storage

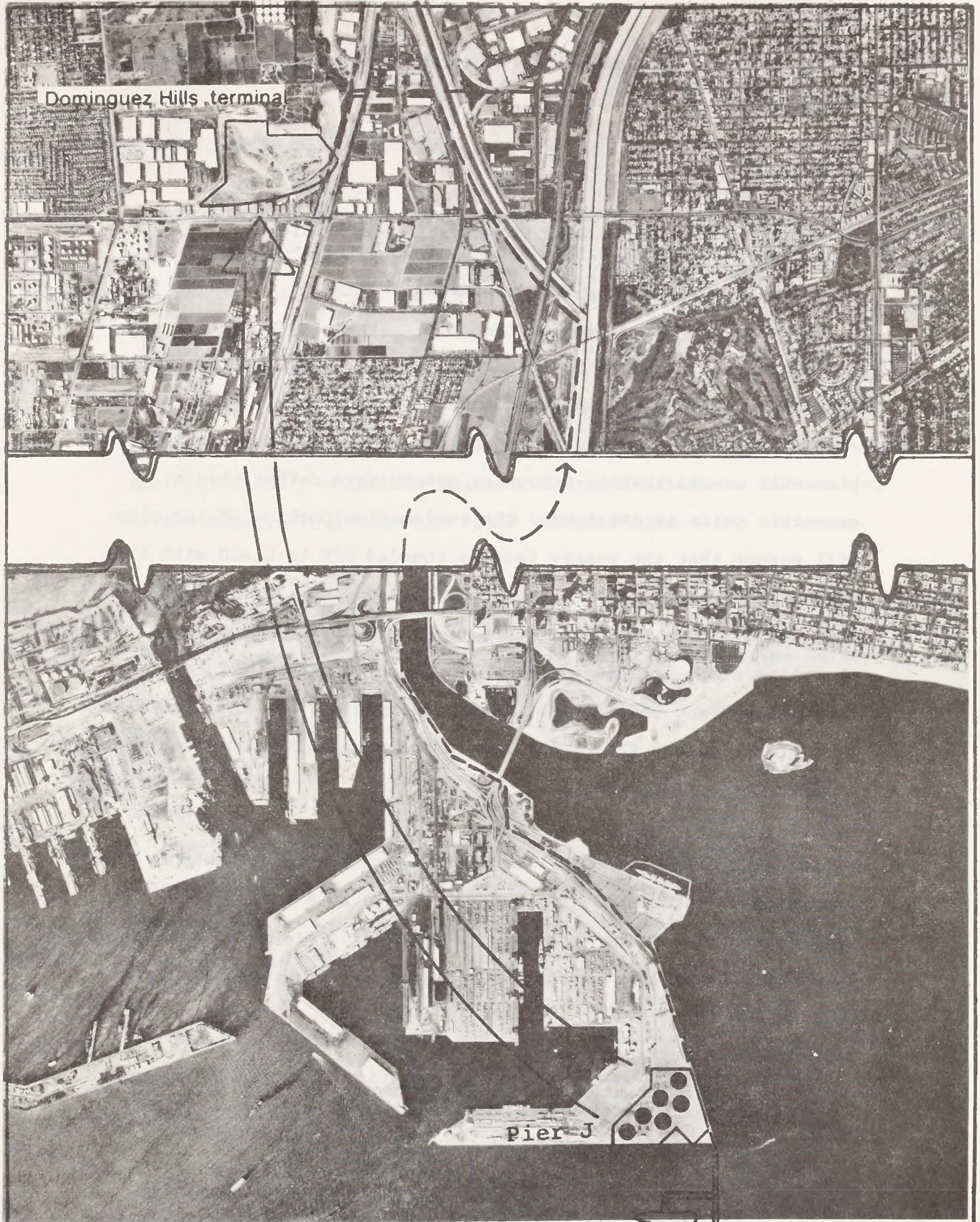

Figure 4.3.1-1 Proposed relocation of storage tanks, constituting inventory from Pier J, inland to Dominguez Hills terminal to reduce adverse impacts

tanks for surge will most likely be required to expedite tanker off-loading.

Agencies with jurisdiction:

U.S. Environmental Protection Agency
California Coastal Zone Conservation Commission
City of Long Beach, Department of Building and Safety
City of Long Beach, Fire Department
City of Long Beach, Harbor Department

3. A plan for mining and reclamation of the Santa Catalina Island Rock Quarry should be submitted and approved before a permit for any expansion of the quarry is granted. The mining portion of the plan will ensure that an irregular quarry face rather than a geometric prism is obtained. The reclamation portion of the plan will ensure that the quarry face is rounded off to blend with the natural topography and that the quarry floor is graded to an undulating rather than flat surface. The quarry floor and shoreline slope from the quarry floor to high water will be hydromulched and seeded with indigenous species, and the shoreline edge of the quarry floor will be planted with indigenous planting stock.

Anticipated effectiveness: The quarry scar can be softened by the inclusion of landscape architectural design in a mining and reclamation plan. The success of revegetation cannot be predicted, but should be at least partially successful with adequate care.

Agencies with jurisdiction:

Los Angeles County Planning Department
California Coastal Zone Conservation Commission

4.3.2 Pipeline route -- California

Tank farm -- Dominguez Hills

1. Foundations, equipment, and facilities at the Dominguez Hills site should be designed to withstand a 7.5 magnitude earthquake on the Newport-Inglewood Fault, and the port facilities should be designed to withstand a 7.0 magnitude earthquake on the Palos Verdes fault zone.

Anticipated effectiveness: Dominguez Hills and Port of Long Beach facilities would withstand highest recorded earthquake intensities on the Newport-Inglewood and Palos Verdes faults.

Agencies with jurisdiction:

U.S. Environmental Protection Agency
U.S. Department of Transportation, Office of Pipeline Safety
County of Los Angeles, Engineering Department
California Air Resources Board

Los Angeles Basin

1. Geological investigations should be provided to county officials by the applicant to ensure that the Puente Hills alignment is not situated on landslide material or threatened by potential landslides.

2. The Puente Hills segment should follow the right-of-way of the proposed major arterial highway, as designated on the approved Diamond Bar master plan.

Anticipated effectiveness (measures 1 and 2): Maximum insurance against pipe rupture from landslides, mud slides or excessive erosion, and of pipe placement in a planned development corridor.

Agencies with jurisdiction (measures 1 and 2):

Los Angeles County, Engineering Department
San Bernardino County

3. During and after construction through the Puente Hills, adequate surface drainage should be provided in areas of steep sidehill cuts and fills, based on detailed plans as approved by Los Angeles and San Bernardino counties.

Anticipated effectiveness: Maximum insurance that pipe rupture from landslides, mud slides or excessive erosion should not occur and that pipe would be placed in a planned development corridor.

Agencies with jurisdiction:

Los Angeles County, Engineering Department
San Bernardino County

Colorado River

1. Local Soil Conservation Service districts that include areas of new construction should be contacted to assist in design of erosion and sedimentation control measures prior to construction of the pipeline.

Anticipated effectiveness: Site specific design of diverted water flows or screening to trap or divert sediment would ensure minimum impact on water quality.

Agency with jurisdiction:

U.S. Soil Conservation Service

4.3.3 Pipeline route -- Texas (including Midland)

El Paso Pump Station and power-line extension

1. The El Paso Pump Station site should be relocated 1 mile west on the existing pipeline right-of-way to remove the pump station and power-line extension from the foreground visibility zone of Hueco Tanks State Park. The use of landscaped berms and painting of valves, buildings, and fences with nonglossy desert colors would further minimize the visual impact.

Anticipated effectiveness: The visual impact would be reduced from a visual contrast rating of more than 20 (high) to less than 10 (low).

Agency with jurisdiction:

El Paso County

REFERENCES

Chapter 4

1. South Coast Air Quality Management District. 1977a. Letter to SOHIO, dated 11 March 1977.

2. South Coast Air Quality Management District. 1977b. Letter to California Air Resources Board, dated 9 March 1977.

3. Williams Brothers Environmental Services. 1976. Environmental Impact Assessment, West Coast/Mid-Continent Pipeline Project. Prepared for SOHIO Transportation Company. Tulsa, OK.

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

5.0 INTRODUCTION

5.0.1 Criteria for determining unavoidable adverse impacts

Not all environmental impacts caused by the construction and operation of the proposed crude oil transportation project can be avoided or totally mitigated. This chapter discusses previously described adverse impacts that may still exist after the application of the committed mitigating measures. Other unavoidable impacts may occur anywhere along the project corridor when applied mitigation is ineffective through noncompliance, or otherwise is not effective. Criteria for unavoidable impacts are based on the assumptions that (1) some adverse impacts would remain after the committed mitigating measures in Chapter 4 are implemented; (2) based on past experience a mitigation may not be completely successful or compliance may not occur; and (3) the impact could not be mitigated or no commitment was made for mitigation. (Proposed mitigating measures listed in Section 4.3 were not used in this analysis of unavoidable impacts.) As in Chapter 3, the unavoidable impacts are related to the specific project proposal as submitted by the applicant. Where planning or design details have not been provided, an assumed worst-case situation has been the basis for the evaluation.

5.0.2 Summary of unavoidable impacts

Unavoidable impacts are discussed under the areas of marine and port areas, urban areas, and nonurban areas as follows.

5.0.2.1 Marine and Port areas

Oil spill potential hazards. One of the most significant unavoidable impacts would be an oil spill, either the irregular major occurrence at sea or in port, or the chronically recurring spills during operations at Long Beach. A statistical projection indicates an annual spill of 389 barrels in Prince William Sound, 439 barrels between the sound and San Francisco, 302 barrels from San Francisco to San Pedro Bay, and 130 barrels in San Pedro Bay (based on applicant's proposed fleet [see Appendix A1.1.1.1-A]). Losses of marine and estuarine wildlife and vegetative species would not be significant as a result of the average spill, but could be major should a spill of several thousand barrels occur, depending upon the concentration of oil, distance from shore, and the time of year. A total loss of a tanker resulting in a major spill of up to 1.2 million barrels is predicted to occur one time in 85 years in coastal waters.

Particularly in Prince William Sound and the Santa Barbara Channel, oil spills would have an unavoidable impact on recreational use of both open water and beach areas for the time required to effect cleanup.

Those unavoidable impacts on the Prince William Sound and northern Gulf of Alaska environment would occur with or without the proposed project resulting from the expected transportation of North Slope crude oil from the Valdez terminal.

Habitat disruption. The dredging in Long Beach Harbor would temporarily eliminate 79 acres of benthic habitat although this unavoidable impact might occur without the project as a result of port expansion that is expected to occur. Benthos and benthic larval fish would be entrained, reducing the food supply of juvenile and adult fish. Increased turbidity would reduce light penetration, thus decreasing phytoplankton productivity and altering larval development (i.e., toadfish). The increased concentrations of suspended solids would clog the gills of suspension feeders and fish.

Construction of the breakwater and trestle would permanently eliminate about 22 acres of benthic habitat. This would destroy existing fish food organisms. Turbid conditions would tend to persist throughout the entire proposed construction period. Dissolved oxygen could be depleted as a result of a biochemical oxygen demand exerted by the resuspended material. In addition, dredging and disposal operations could result in the possible introduction of heavy metals and nutrients into the water column.

Air quality. Only tankers with inert gas or equivalent systems would use the terminal. The monitoring of offloading operations would preclude purging in port. Under normal operations, the tankers would pass Point Conception prior to any purging of hydrocarbon vapors from cargo tanks. Since no monitoring procedures at sea (e.g., by an electronic monitoring system) have been committed and since purging could not be detected exterior to the tankers, purging south of Point Conception cannot be ruled out. If a tanker purged cargo tanks under adverse meteorological conditions while in a coastal air shed, oxidant levels onshore could increase up to 0.12 ppm for a short time (since the tanker would be moving at more than 10 kt, the level would not be sustained). The maximum 1-hour average oxidant increment would represent at most 25 percent of the Federal oxidant standards (0.08 ppm). A more severe impact would occur if the hydrocarbons were from an oil spill of at least 200 barrels. The latter event is expected at least once during the life of the project. There would be additional emissions (sulfur and nitrogen oxides, and particulates) from tanker stacks. These emissions would often drift ashore but would have an insignificant effect on meeting standards.

Visual resources. The proposed siting of inventory storage tanks on Pier J in Long Beach Harbor would violate the California Coastal Plan guidelines. The expansion of the rock quarry on Catalina Island to provide breakwater material would also have significant adverse impacts on coastal resources.

5.0.2.2 Urban areas

Significant unavoidable impacts to urban areas are primarily associated with the conversion/construction phase of the project. Ambient noise levels would increase in communities near some pump stations during construction. Some communities would be subjected to increased noise levels for up to 25 days.

Trenching and other construction activities would cause a temporary disruption and slowdown of both commercial and private surface transportation. This impact would be temporary, and is not expected to last longer than two weeks in any particular area. The especially deep trenches along the Los Angeles flood control channel would encounter many foreign pipelines and utilities. The potential exists that some of these lines may be broken or disabled by construction activities. This would cause an interruption in a particular utility (gas, water, telephone) or transportation system until repairs are made. The area primarily affected by these activities would be that involved in new construction from the Port of Long Beach to Redlands, California, and at Midland, Texas. Total mileage involved would be approximately 90 miles.

5.0.2.3 Nonurban areas

Greatest unavoidable impacts to nonurban areas would be to the presently undisturbed natural open spaces. Where there are new construction activities, the entire width of the right-of-way along the proposed pipeline alignment and the sites for ancillary structures would be disrupted. Approximately 150 miles of open space areas would be involved in new construction. Approximately 1,700 acres of native vegetation within the work areas would be forfeited, eliminating wildlife habitats and diminishing natural erosion protection. Destruction of individual undetected Rare or Endangered plants that exist within the construction corridor could occur even with a mitigating measure designed to fully protect individual species.

During project operation, maintenance activities would necessitate access roads. Occasional grading activities on the access roads would inhibit revegetation during the life of the project. The occurrence of small leaks, which were undetected for a period of time, or a major rupture would result in unavoidable impacts, particularly on vegetation, water resources, and wildlife. The severity of impact would be dependent on the specific location of a spill.

Visual impacts upon open-space areas would be caused primarily by pump stations, power-line extensions, passive microwave reflectors, and active microwave repeater/receptor towers at pump station sites. Some of these facilities are proposed in highly scenic or visually sensitive areas. Many of the facilities would be skylined when seen from critical observation areas. Many of the visual impacts have been minimized by committed mitigating measures through relocation, screening and camouflage. Unavoidable visual impacts would remain for the life of the project and degrade the overall scenic quality of open-space areas.

5.1 CLIMATE

There would be no measurable impacts on the climate.

5.2 ECOLOGICAL_INTERRELATIONSHIPS

5.2.1 Sea Leg

Port_Valdez area

The northeast Pacific Ocean is now relatively unpolluted compared to other oceans. In this area, Port Valdez and Prince William Sound are most vulnerable to biological impact from activities associated with the proposed project (USDI, 1972).

Worst conditions of wind, waves, reduced visibility, precipitation, darkness, fog, snow, or temperature are often present at the time of an oil spill as a causative factor of the accident. They also inhibit clean-up efforts. Equipment and methodology do not now exist for the control and cleanup of large oil spills where waves exceed 3 feet in height. This would also be true for most small spills along much of the tanker route, and is especially true in the Gulf of Alaska.

Available information (APSC, 1971; U.S. Coast Guard, 1972; Dillingham Corporation, 1972) indicates that accidents and operational discharge of oil would occur in spite of full utilization of technological advances and most stringent regulations. Thus, a gradual buildup and accumulation of pollutant hydrocarbons in ocean waters is expected during the life of the North Slope oil fields, with related adverse effects on biota.

Port of Long Beach area

Dredging in the port would temporarily eliminate 79 acres of benthic habitat. Benthos and benthic larval fish would be entrained, reducing the food supply of juvenile and adult fish. These would be temporarily displaced, causing overcrowding and stress to adjacent populations. Some nutrient release is expected, possibly causing potentially adverse phytoplankton blooms. A local increase in BOD and release of toxic pollutants would occur; both would probably cause some organism mortality. Increased turbidity will reduce light penetration, thus decreasing phytoplankton productivity and altering larval development. Redeposition of suspended solids would bury and/or smother suspension feeders, reducing available fish food.

Construction of the breakwater and trestle would permanently eliminate about 22 acres of benthic habitat. This would destroy existing food organisms for fishes. The breakwater would reduce wave action on the seaward face of Pier J, modifying the existing species composition.

5.2.2 Terrestrial

The greatest unavoidable impact on the ecosystem would be habitat changes on approximately 1,700 acres of natural vegetation within the cleared corridor after new construction. Alterations on vegetation would reduce plant species richness and cause shifts in the relative dominance of species inhabiting disturbed communities. With the exception of Threatened and Endangered plant and animal species described later, unavoidable impacts to the ecosystem are considered inconsequential because of the broad occurrence of similar plant/animal communities as compared with the relatively small area taken from production by the proposed project.

5.2.3 Aquatic

Physical removal and disturbance of aquatic plants, phreatophytes, and animal communities would occur at the major river crossings during construction. In case of a pipeline break, the repair would cause essentially the same impacts. The effects on the aquatic plants and animals should be short-term and limited to the actual area of physical disturbance including the immediate downstream areas. The affected aquatic ecosystem should be essentially recovered within two years.

The impact of an oil spill from the proposed pipeline in the Colorado River, for example, could be slight to catastrophic to the aquatic ecosystem, depending on the volume of the spill. At the least, one could expect reduction of the periphytic and benthic microscopic plants downstream of the spill. Oil remaining on the shoreline and on bottom sediments would also prevent or retard recolonization (Cairns et al., 1972). In this situation, 3 to 10 years probably would be required for benthic aquatic and shoreline plant life to become reestablished.

5.3 GEOLOGIC HAZARDS

While geologic hazards are not of themselves impacts, these hazards can generate impacts. There is a 50 percent chance that the California portion of the project would be subjected to an earthquake of magnitude 7.0 or greater during its 25-year designed life. Between the Port of Long Beach and Indio, despite the application of mitigating measures, some damage from strong shaking or foundation instability would probably occur at various ancillary facilities. Oil leakage and possibly fire from these damaged facilities could be the direct result of an earthquake. At the major faults in California, 9,200 barrels of oil could escape from an earthquake-caused rupture assuming that valves operate as expected. Environmental components impacted by this potential spill would be soil, vegetation, and groundwater, with secondary effects related to wildlife and local human resources.

5.4 SOILS

Identifiable, unavoidable adverse impacts on soils include:

1. Loss of protective vegetation on approximately 1,700 acres of previously undisturbed lands for a period of 2 to 10 years as a result of construction activities.

2. Permanent soil compaction and loss of protective vegetation on approximately 300 acres of permanently maintained access roads and pump station sites for the life of the project.

3. Identifiable but unmeasurable loss of soil and on-site productivity from water action following construction and during operation.

4. Loss of soil as fugitive dust during construction at a rate of approximately 0.5 ton per mile with no discernible impact on productivity.

5. Loss of soil fertility from profile mixing during construction on approximately 21 acres of cropland in the Los Angeles Basin and Palo Verde Valley. Reduced crop yields could persist for two to three years.

6. Soil sterilization from small undetected leaks on soils underlain at shallow depths by hardpan or caliche. Migration of oil would be toward the surface within a few days following saturation. Without reclamation measures, sterilization could persist for a year to a few years, depending upon the degree of contamination by the oil (Schwendinger, 1968).

7. Soil sterilization from pipeline rupture. As with the small leak, the areal extent and duration of sterilization would vary with the magnitude of spill and the reclamation measures applied.

5.5 WATER RESOURCES AND QUALITY

5.5.1 Sea Leg

Oil spills could be expected from both operational sources and tanker accidents. Operational spills would be expected to occur rather frequently, approximately 23 per year at 700,000 bbl/d throughput. The amount spilled would be relatively small, however, with an estimated 7 barrels per spill, distributed about equally between each port area and the open sea. Accidents leading to spills, while much rarer, would result in much larger amounts spilled. A study prepared for BLM by ERT, Inc. (Appendix A1.1.1.1-A) indicates a probability of 0.56 in the 25-year project life that a tanker would be a total loss; i.e., a total spill of up to 1.2 million barrels, as noted. Statistics for those years without a major spill are also indicated in Section 5.0.2.1. Should Columbia Glacier enter an unstable condition (retreat), tanker-iceberg collisions would be highly probable in the absence of mitigating factors. These hazards would be present for all North Slope oil tankering. Although precise estimates are currently unavailable, some increase in the probabilities and sizes of annual oil spills in Prince William Sound could be expected from the SOHIO project.

The amount of oil that can be contained and recovered would depend on the containment and recovery efficiency, time differential between oil spill and initial containment-recovery actions, and oceanic and atmospheric conditions. Because tankers would be fully skirted prior to unloading and fueling operations at Pier J, the amount of oil spilled and not contained at Pier J would be significantly reduced relative to the data in Appendix A1.1.1.1-A and in Chapter 3. However, effective clean-up operations in coastal areas and in the open ocean are exceedingly difficult, if not impossible, when seas exceed 3 feet or when currents are more than 1 to 2 knots.

When oil is spilled in a marine environment, it immediately begins to weather. This involves a change in composition through physical, chemical, and biological processes. The rates of each are dependent on the type of oil, temperature, nutrient level, etc. The process is called "aging" or "weathering" and results in a residue that has much less adverse effect on water quality than freshly spilled crude. This factor, coupled with any physical processes that promote mixing and circulation within the water column under a spill, indicates that serious degradation of water quality is a transient phenomenon. In open ocean areas, after three to four days, the effect of oil on water quality is reduced to an insignificant level. In bodies of water such as Port Valdez, where evaporation is slower or mixing is restricted, poor water quality may persist longer. Present information is inadequate to predict this length of time.

Oil spills may cause other degradation of water quality by contributing heavy metals and other trace elements. Nickel and vanadium are the most abundant. However, investigations to date concerning the impacts of heavy metals from offshore petroleum operations indicate that concentrations were diluted to a range within that found in ocean water.

When oil is spilled, it spreads and is carried along by wind forces and water currents. This increases the area over which water quality degradation takes place. Within three days, a spill can move as much as 35 miles if spilled at certain locations along the route. From Port Valdez to Cape Hinchinbrook entrance, and within the Santa Barbara Channel, this generally would mean that the oil would reach shorelines where it could impact important water resource areas such as bays and estuaries. Examples include Shoup Bay, Sawmill Bay, and Galena Bay in Alaska, and the boat harbors at Santa Barbara and Ventura.

Port of Long Beach area

In Long Beach Harbor, adverse impacts would accrue during dredging and disposal of 2.5 million cubic yards of bottom sediments, placement of 2.6 million tons of breakwater rock, and construction of the pier-supported trestle. In addition, benthic aquatic populations would be destroyed or displaced during the construction period.

5.5.2 Surface water

Construction and operation of the system is expected to cause no long-term changes in the availability, use, or quality of surface water resources.

Temporary unavoidable impacts would result from excavation and placement of new pipeline below the riverbed at the Colorado and Pecos rivers.

At the Colorado River, an estimated maximum 35,000 cubic yards of sediment would be carried downstream as far as Imperial Dam during the estimated 18-day construction period. Water quality standards for turbidity levels in California and Arizona would be exceeded during this time, and lowered dissolved oxygen levels could reduce benthic populations temporarily. Subsequent increased water releases from upstream dams to satisfy high summer demands for agricultural and urban water would cleanse the stream of most smothering deposits of sediments within eight months after construction ceased.

A similar temporary impact would result at the Pecos River crossing with displacement of around 3,000 to 4,000 cubic yards of sediment over an approximate 10-day construction period.

Longer-term unavoidable but reversible impacts would result in the event of pipeline rupture or undetected leaks at the major streams identified in Section 3.1.5. These are presented on a "worst case hypothetical" basis resulting from uncontrollable natural phenomena or "state-of-the-art" faults in the detection system, mitigated to the extent possible by activation of an existing emergency oil spill contingency plan. The contingency plan will be submitted by the applicant for review and approval by EPA and the various states prior to start-up.

Other than health and aesthetic hazards, the chief difficulties associated with the presence of oil in water are the production of tastes and odors and interference with water treatment processes (Ineson and Packham, no date) for disposal or conversion to urban or industrial use. The length of time required to dispel the oil for these purposes at a specific site would vary with the extent of contamination and the effectiveness of the contingency plan in responding to an emergency situation.

5.5.3 Groundwater

The probability of contamination of groundwaters by oil spills and small leaks is based on nationwide averages of the numbers and sizes of spills annually. Hypothetical examples are presented in Sections 3.1.4 and 3.1.5 as events that could not be avoided but could be mitigated by oil spill contingency plans. Since most groundwaters that would be affected by oil contamination along the route are used for domestic purposes, the concentration would be required to be reduced below 0.1 to 0.5 mg/l which is the threshold of odor concentration (Ineson and Packham, no date). Until this level is reached by supplemental pumping and disposal of contaminated water, use, at least for domestic purposes, would be suspended. The suspension time would be dependent upon the effectiveness of the oil spill contingency plan at specific locations.

5.6 AIR QUALITY

5.6.1 Port Valdez air shed

The possibility of high levels of sulfur dioxide near the terminal at Port Valdez has been identified. Frequent occurrences of a low inversion lid and wind toward shore could result in severe impacts along the shoreline as a result of the trapping of ambient sulfur dioxide followed by movement down the steep slope that forms the southern boundary of the terminal. Modeling calculations indicate that, under the most severe conditions, concentrations as high as 6,700 $\mu g/m^3$ (three-hour average) would be experienced. Similarly, modeling studies indicate that oxidant levels will be above Federal standards in Port Valdez. Approval of the SOHIO project would provide more tankers with segregated ballast for the Alaska trade; but no clear advantages or disadvantages could be positively identified in the BLM-directed study which produced these data (see Section 3.1.6). These impacts would occur from loading 1.2 to 2 million barrels of oil daily, whether or not the SOHIO project was implemented.

5.6.2 Los Angeles Air Shed

Construction

Unavoidable impacts during construction would be moderate. Nitrogen oxides arising from construction equipment can only be mitigated to a degree by proper adjustment of engines on construction equipment; nevertheless, nitric oxide emissions would be fully diluted before they would be oxidized further to nitrogen dioxide (NO_2) and thus be subject to the NO_2 standards. The contribution to air shed levels would amount to 0.2 percent. Although this is considerable for one project, it is not expected to lead to additional violation of the California one-hour NO_2 standard (0.25 ppm). Hydrocarbon emissions would lead to additional violations of the Federal hydrocarbon standards. Adverse impact on oxidant standards would be minor.

Similarly, sulfur dioxide (SO_2) and carbon monoxide (CO) emissions are unavoidable, but of minor significance. The degree of unavoidable impact from airborne dust would depend on the level of watering behind equipment and watering of soil during construction. The impact could be significant if minimal watering were employed during low speed wind and stable atmospheric conditions.

Normal operation

Emission trade-offs remain proposed mitigating measures at this writing; consequently they are not reflected in this chapter as reduced unavoidable impacts. It is expected that, prior to project approval, the applicant will have obtained acceptable trade-offs on a more than one-for-one basis. The project, as approved, can then be expected to result in insignificant adverse, or even beneficial, impacts on air quality from normal operations. The only remaining impacts from operations would then be in the immediate vicinity of Pier J and storage tanks, and perhaps at sea if operational procedures are forgone and purging occurs south of Point Conception. Seldom would a standard be violated in a populated area, such as near the Queen Mary or along the beach or in Santa Barbara or Ventura counties. (See Figure 2.1.6.5-1 for a summary listing of the standards.)

Total suspended particulates (TSP). Only under high onshore wind conditions would tanker exhaust gases reach the mainland in significant concentrations before being diluted. This does not happen frequently (winds of greater than 21 mph velocity only occur about eight hours per year). Other circumstances must be present to result in a violation of the California 24-hour TSP standard (100 $\mu g/m^3$) downwind: emissions from two or three tankers discharging simultaneously and a high ambient particulate level (a frequent event and compatible with strong wind conditions). This standard would probably be violated only a few times during the life of the project. An accident leading to an oil fire could result in severe smoke and violation of the 24-hour particulate standards.

Sulfur dioxide (SO_2). Violations of the California 24-hour SO_2 standard (0.04 ppm) would occur with perhaps a slightly greater frequency than violations of the TSP standard. Three tankers discharging simultaneously under strong wind conditions would produce a maximum feasible SO_2 level of approximately 0.006 ppm over 24 hours in populated areas downwind (15 percent of the standard); the corresponding calculation indicates a maximum particulate level which is about 25 percent of the standard. The analysis for low wind speed and stable atmospheric conditions, however, indicate that SO_2 increments, which are appreciable fractions of the California 24-hour standard, could occur at least a few times a year (Table 3.1.6.1.2-7). The trend toward higher basin-wide ambient levels for the two pollutants are similar near Long Beach (compare Figures 2.2.6.1-1 through -4).

Nitrogen oxides. Substantial nitric oxide (NO) exhaust emissions would cause no violation of standards under any circumstance. The only nitrogen oxides standards are for nitrogen dioxide (NO_2). The tanker exhaust NO would be fully diluted before it could be oxidized to NO_2. Even with the assumption that the nitrogen oxides were instantly oxidized to NO_2, the California one-hour standard would not be exceeded (Table 3.1.6.1.2-7). Average emission levels of nitrogen oxides (NOx) would be less than one-half ton per day, or about 0.04 percent of total NOx emissions in the air shed during 1980 (Table 2.2.6.1-3).

Hydrocarbons and oxidant. The potential for mitigating the most severe hydrocarbon emissions and oxidant impacts (Chapter 3) is good. Since monitoring of operations has been committed, purging in port can be ruled out. As long as commitments and lease stipulations for Pier J operations are actualized, violations of hydrocarbon and oxidant standards should only be contingent upon emissions from storage tanks. Increments to hydrocarbon ambient levels downwind from stoarge tanks during low wind speed conditions would represent 5 to 50 percent of the Federal hydrocarbon standard; this range of estimation results from the differing emission factors claimed to be applicable to storage tanks. The hydrocarbon standard is exceeded on more than half of all days where measured in the air shed. Emissions of hydrocarbons in exhaust gases from ship stacks would be minimal.

Accidental spills. According to analysis, approximately 25 percent of any Prudhoe Bay oil spilled would evaporate in the first 24 hours; approximately 10 percent would evaporate in the first hour (Woodward-Clyde, 1976). Consequently, oxidant impacts cannot be prevented by any means when significant quantities of oil are spilled. The impact depends on the size of the spill, its location relative to populations, and the intervening meteorology and terrain conditions.

A spill in the Port of Long Beach area of around 200 barrels would approximate the quantities of hydrocarbon vapors released by ballasting into cargo tanks. If a spill occurred during night or morning hours under low inversion conditions (usually summer), oxidant levels similar to those modeled could be expected downwind of the spill; that is, oxidant levels could increase a modest 25 percent, could double, or from a major spill, could even reach record oxidant levels. A spill of at least 200 barrels under low inversion conditions, or a larger one under less severe weather would probably occur at least once during the life of the project in California coastal waters. The impact could range from minor to very severe.

5.6.3 Pipeline route

During construction, there would be a considerable amount of dust emission because of arid conditions along the pipeline route east of Beaumont. There is insufficient water to suppress all airborne dust. It is assumed here that airborne dust would be reduced by watering east of Beaumont only when the safety and/or efficiency of the crew were at stake. Increments to particulate ambient levels that are up to 50 percent of the California 24-hour standard, and 16 percent of the Federal standard, could occur 1,600 feet (about 500 meters) downwind from construction of pipeline segments. The increments could be about twice as severe (approaching the California standard) near pump station construction. Southeast California and western Arizona would have new construction segments with high ambient dust levels and, consequently, air quality in those areas would be most sensitive to further emissions.

A major oil spill from the pipeline anywhere in California or near Phoenix and Tucson would impact air quality for one or more days if a low inversion and moderate sunlight were present. Historical records indicate that this event has a low probability of occurring during the life of the project. Normal operations would result in insignificant impacts.

5.6.4 Midland and vicinity

No significant impacts on air quality are expected from construction. See Section 5.6.2 for a comparable analysis. During operations the storage tanks would have an impact on the area's ability to meet the Federal hydrdocarbon standard (see Section 5.6.2 above). Modeling indicates only marginal increments of oxidant would result from reaction of the hydrocarbon emissions with ambient nitrogen oxides. If the emissions factor proposed by the Texas Air Control Board is used, the increment would increase to about 6 percent of the Federal standard. A major oil spill or fire at the terminal could impact air quality in Midland; this event is unlikely during the life of the project. Section 5.6.3 lists unavoidable impacts related to the pipeline.

5.7 VEGETATION

5.7.1 Sea Leg

Phytoplankton

Coastal and marine phytoplankton populations would be affected by acute and chronic oil spills. The effects of a spill, and consequently the impacts, would be influenced by many variables, such as current (dilution factor), time of year, location, concentration, and duration of exposure, as well as man's response to the spill (clean-up operations). Mitigating measures should be 80 percent effective in reducing the operational and accidental spill rates and volumes, and containing and recovering spilled oil within Long Beach Harbor. However, major spills from tanker accidents could still occur, resulting in high mortality in the immediate area of a spill. The planktonic organisms most susceptible to adverse impacts from spills are those associated with the neuston community or the surface layers of water. Sensitive or critical areas include Prince William Sound, upwelling areas along the California coast (March to July), and most nearshore areas during the spring and summer blooms.

Benthic algae

Benthic microflora is very vulnerable to oil pollution. The minimum oil-persistence times for the sand and mud bottoms where much of the microflora occurs range from 3 years (sand) to 10 years (mud) (Naughan, 1973; Thenton, 1973). Significant losses in these plants would occur throughout the life of the project and for many years after its abandonment. In the case of large spills, benthic microflora would probably be eliminated completely from impacted areas. This would significantly impact many benthic animals which depend upon the microflora for food.

Intertidal species would be more severely impacted than subtidal species, although both would suffer. Chronic low-level pollution would reduce species diversity and the general vitality of individual specimens. Large spills in Prince William Sound or along the California coast south of Monterey would eliminate intertidal algae in impacted areas for three years or longer. Such spills would permanently eliminate short-range endemics. Reduced species diversity, the elimination of all algae from certain areas (for periods of up to several years), and similar phenomena would, of course, impact all other organisms associated with algae.

Marine spermatophytes are more sensitive than many of the algae because they lack the mucilaginous covering common to many algae. Eelgrass, Zostera marina, is widespread in Prince William Sound and adjacent areas and occurs all the way to Long Beach. It is very sensitive to even minute amounts of oil which weaken the plant and make it susceptible to attacks of a parasitic fungus. Zostera beds in Prince William Sound and possibly in southern California would be significantly reduced in size. Some could be completely eliminated. Eelgrass beds might not recover for as long as 10 years after completion of the project because of the persistence of oil in those areas.

Elimination and/or decreases in the size and number of Zostera communities would probably be the most important impact upon benthic vegetation. The Zostera communities are extremely important to many species of birds as well as invertebrates and certain fish. Marsh grasses are quite vulnerable to oil pollution. In cases of a large spill, oil would compact basal areas of plants and substrate. The overall impacts upon marsh flora should not be severe because of prevailing currents.

5.7.2 Terrestrial

New construction activities would cause unavoidable impacts upon vegetation communities involving the removal of vegetation within the construction right-of-way, pump station sites and power transmission line maintenance roads. Listed below, by biomes, is a general summary of the acres of native vegetation stands that would be removed and the animal unit months (AUMs) lost during the new construction phase (Table 5.7.2-1).

In summary, the total grazing AUMs lost constitutes a minor unavoidable impact. Approximately 50 to 75 percent of the native vegetation would be permitted to become reestablished after the construction phase.

Table 5.7.2-1

Estimated Unavoidable Impacts on Vegetation Communities From Construction

BIOME	Acres	AUMs
California Coastal	55	21
Colorado Desert	340	0
Yuman Desert	259	6
Arizona Upland Desert	50	5
Desert Grassland	54	6
Chihuahuan Desert	90	6
Trans-Pecos Desert Scrub	10	1
Short-Grass Prairie	855	152
Total	1,713	197

5.7.3 Rare, Threatened, or Endangered plant species

The proposed project occurs in regions known to be habitats of Rare, Threatened, or Endangered species of plants. Individual plants may be destroyed if prescribed protection measures fail during construction or maintenance activities. No base-line data are available to determine the areal distribution or quantification of these plants by location. A survey to locate these plants along the route will be made prior to construction.

Colorado Desert Biome. This biome contains 327.7 acres of creosote bush-bur sage plant community which would be removed by the construction phase. Under normal conditions this plant community provides habitat favorable to glandular ditaxis; little San Bernardino Mountain linanthus; scaley-stemmed sand plant; desert arjenia; and Mojave fishhook cactus.

Yuman Desert Biome. Approximately 30 acres, which would be removed by construction of the Gila and Coolidge pump stations and maintenance roads, normally provide habitat favorable to Neolloydia erectocentra, var. acunensis.

Arizona Upland Desert Biome. Twenty acres would be removed by construction of the Black Mountain and Redington pump stations. Normally, those 20 acres provide habitat favorable to Neolloydia erectocentra var. erectocentra.

Trans-Pecos Desert Scrub Biome. In the vicinity of Anthony, 24 acres of habitat favorable to Opuntia arenarea could be impacted by the operational stage.

Short-Grass Prairie Biome. There are 886 acres stretching eastward from Jal that contain habitat favorable to the dune unicorn-plant. That area would be disrupted during the construction phase.

5.8 WILDLIFE

5.8.1 Sea Leg

The following unavoidable impacts would occur, should a major spill or chronic contamination take place. Oil-generated impacts will be possible from all North Slope oil shipments from Port Valdez, not only from the SOHIO project.

Port Valdez to Port of Long Beach

Benthos and fisheries. Species diversity of intertidal and shallow subtidal organisms would decrease in Prince William Sound. Fisheries dependent on intertidal species, such as the razor clam, Siligua patula, would decline. Razor clams in the vicinity of Prince William Sound, and possibly populations in southern California, would become contaminated and be inedible. This condition would probably occur at a minimum of once a year and last for several months. If a large spill were to reach a clam flat, the clams could remain inedible for at least 10 years because of the persistence of oil in the substrate. The population would certainly decline and could be eliminated. Other organisms associated with the clam flats would also be strongly impacted.

Pacific herring, Clupea pallasi, are major planktivores from Valdez to Long Beach. They are an important food source for many larger animals (e.g., seals and salmon). In some areas, including Prince William Sound, they deposit their eggs intertidally. Since 1970, Prince William Sound has supported a $250,000 a year herring-eggs-on-kelp fishery. This fishery and the herring population in the contaminated area would markedly decline.

Salmon throughout Prince William Sound and along the entire route would suffer chemo-receptive interference from petroleum hydrocarbons. The actual effect of this interference upon spawning is difficult to predict. However, the probability of at least some spawning streams being eliminated would be great with spills involving several thousand barrels because fish would avoid the contaminated areas. In other areas, chemical interference could prevent the salmon from finding their home stream.

Benthic species in and around Prince William Sound would be stressed in case of an oil spill. Because of their life histories, some of the important commercial species would show substantial declines. These species include: king crab, Paralithodes cantschatic; Dungeness crab, Cancer magister; and Tanner crab, Chionoecetes sp. Since Tanner crabs are the second most abundant macroinvertebrates in the Gulf of Alaska, profound changes would occur if these species sharply declined or were eliminated.

In addition to the fish already mentioned, all species whose eggs, larvae or fry occur in the upper portions of the euphotic zone in Prince William Sound and southern California would suffer losses from oil. These losses may or may not be significant, depending primarily upon the concentration of oil and the time of year.

Marine mammals. Because they are high in the food chain, many marine mammals (e.g., pinnipeds, the sea otter, and the toothed whales) could utimately suffer from an ecosystem contaminated with oil, although such a situation should not happen as a result of this project. Direct adverse impacts on mammals generally would be limited to those that depend wholly on their fur for insulation and reside in habitats likely to have accumulations of oil. Sea otters are the principal species in this category. They are found in Galena Bay, Tatilek Narrows, on both sides of Cape Hinchinbrook entrance, and along the California coast from Santa Barbara County to Santa Cruz County. All of these areas could be impacted by spilled crude oil.

Marine and estuarine birds. The greatest primary threat to wildlife may well be the impact of oil spills upon birds which are characteristically of the diving, colony-nesting, water-roosting or flocking species. When coated with crude oil, birds lose their buoyancy and ability to fly. They lose their insulative air layer and may die of exposure. They suffer from internal toxicities when oil is ingested and are thereupon not likely to contribute to annual production for that year. Also, birds, especially migrating birds, are unavoidably adversely affected if their food supply of benthic animals is destroyed by an oil spill along feeding grounds.

The long-term damage to bird habitats from chronic oil pollution during the breeding season may exceed that caused by irregularly occurring major spills. This is especially true in Long Beach where a statistically predicted 130 barrels of oil a year would be unavoidably spilled during operations.

Groups believed to be the most susceptible to contamination by oil along the Sea Leg from Valdez to Long Beach are: puffins, murres, guillemots, auklets, murrelets, cormorants, loons, grebes, eiders, scoters, and oldsquaws. Shearwaters, fulmars, albatrosses, petrels, gulls, terns, shorebirds, and some ducks and geese are also vulnerable to contamination, but less so than divers.

Port of Long Beach area

Zooplankton. Unavoidable impacts to coastal and marine zooplankton populations would occur from acute and chronic oil spills. Mitigating measures should be effective in reducing the operational and accidental spill rates and volumes, and in containing and recovering spilled oil within Long Beach Harbor. However, the immediate areas of acute spills could inflict high mortality on fish eggs and larvae of benthic organisms. Copepods, a dominant group in the zooplankton, have been found to ingest and depurate oil droplets without apparent harm. However, since copepods serve as an important link in the food chain, the ingested hydrocarbons could possibly become magnified in the food chain.

Zooplankton mortality within the dredging and filling plume will result from lowered dissolved oxygen levels. Cessation of dredging and filling activities will allow reestablishment of the zooplankton population.

Benthic fauna. The base of the breakwater and the dredging operation will eliminate about 21 and 79 acres of outer Long Beach Harbor's benthic habitat, respectively. The benthic habitat covered by the breakwater will be permanently lost. The process of repopulation of dredged areas is expected to take place rapidly after cessation of the dredging activity. A complete restoration of the benthic community will depend upon such indeterminable variables as buildup of oil residues from spills and specific changes in water circulation that could influence benthic community development.

Redeposition of suspended sediments on benthic habitats adjoining the dredging and filling in the Long Beach Port areas would cause some mortalities in deep burrowing adult siphonate suspension feeders.

Rocky shore fauna. There would be some mortality of sessile suspension-feeding epifauna, such as *Mytilus edulis*, and boring and suspension feeding forms of bivalves on the subtidal rocky shore habitats adjacent to the dredging and filling areas.

The breakwater would further shelter the seaward face of the Pier J rocky shore revetment from wave action. This reduction in exposure to wave energy would bring about a modification of the faunal composition on the Pier J shoreline; the faunal species diversity would probably become lower than present.

Larval fish. The dredging would entrain fish with benthic larval stages (i.e., toadfish) as well as postlarval flatfish. Associated turbidity would reduce light penetration, which could alter the total developmental interval and embryo development. Either alteration would increase the chances of predation and overcrowding.

Adult fish. Fish around Pier J would be temporarily displaced by dredging. This would cause mortality to flatfish, croakers, and surfperch, among others, by overcrowding and eliminating benthic food organisms. Turbidity can decrease the population by reducing sight feeding and damaging gills. Deepening the channel would continue present species imbalance by increasing deepwater habitat preferred by young croakers, queenfish, and anchovies. The anchovy live-bait fishery would be restricted by deeper channels.

Construction of the breakwater would cause temporary loss of fish in the expansion area. Permanent reduction in the benthic food supply of croakers and flatfish also would occur. There would be a change in species distribution from those preferring soft-bottom habitat to those preferring rocky habitat.

5.8.2 Terrestrial and aquatic mammals

Unavoidable adverse environmental effects of the proposed project on wildlife and the duration of these effects would depend upon the existing population of the affected species, the type of community involved, and the amount of habitat altered or destroyed by construction and operation. The major unavoidable adverse impacts on wildlife include:

1. Mortality of animals that utilize estuarine and littoral zones extensively for food gathering.

2. Disruption of reproductive activities as a result of either nest or den destruction or physiological stresses.

3. Loss of terrestrial habitat from right-of-way clearing and disturbances.

4. Loss of aquatic habitat from siltation and turbidity from stream crossings and erosion.

5. Short-term displacement of animals because of the noise and human activity.

Through beach vegetation and carrion links in the food web, it is possible that oil pollution of littoral zones could affect terrestrial mammals which either intermittently or constantly use the beaches. During winter, in particular, Sitka deer and other foragers might be forced to utilize beach and intertidal zone plants and would be vulnerable to effects of ingesting oil-polluted vegetation. River otter and mink utilize estuarine and littoral zones extensively for food gathering. Both black bears and brown bears travel the intertidal areas from mid-May through July, foraging on beach vegetation and feeding on salmon and carrion. The covering or destruction of intertidal vegetation and loss of salmon runs, could therefore affect bears. The ingestion of oil-covered carrion by bears, foxes, coyotes, mustelids, and shrews would result in petroleum hydrocarbons being assimilated directly into the top of the food chain. The relative toxicity of oil to these mammals is not known, however. In the Channel Islands, California, the beach-feeding state-classified Endangered island fox could be eliminated should a tanker break up or a series of lesser spills occur. Mitigating measures proposed by the applicant broadly cover subjects of concern to wildlife resources; however, these measures are quite general and lack specific detail. Thus, it is difficult to determine their effectiveness.

In areas of new construction, there would be unavoidable loss of wildlife habitat. This loss would be long-term and continuous at pump station sites. Where new pipeline is installed or existing lines buried, the duration of habitat loss would depend upon the specific location of the construction site. Habitat loss, while unavoidable, would be short-term in biologically stable plant communities; e.g., chaparral, because the potential for recovery is high in these communities and recolonization would occur rapidly. However, for the biologically simple, low-stability plant communities, (e.g., creosote bush-bur sage), the recovery potential is low and adverse effects on wildlife in these communities might be long-term and permanent. In all areas of new construction, use of the area by many organisms as habitat would be unavoidably preempted, at least temporarily.

Each stream and river crossing requiring new construction would have unavoidable adverse effects on the aquatic biota since there would be some measure of disturbance and significant increases of turbidity and sedimentation even with the most conscientious mitigation efforts. There would be a temporary reduction in basic productivity. The reproduction of many species would be greatly curtailed for at least one season over a considerable segment of the stream below the crossing, and feeding and growing conditions for fish and invertebrates would be lowered in this segment for at least one growing season.

Clearing of riparian vegetation, substrata disruption, and temporarily increased siltation on those rivers requiring new construction (Los Angeles, San Gabriel, Santa Ana, Colorado, and Pecos) would cause unavoidable short-term (3 to 10 years) impacts to these aquatic ecosystems. The primary direct impact would be disruption of existing populations of aquatic biota. Secondarily, diminished reproductive success of benthic invertebrates and fishes would occur.

Depending upon the amount of siltation produced by construction activities on the Colorado River crossing, the backwater lakes and the Imperial and Cibola national wildlife refuges would be impacted to a greater or lesser degree. If construction were confined to periods when the river was at low flow, as proposed, impacts should be minimal.

The most serious unavoidable impact to wildlife would be an accidental oil spill, especially if the oil entered an aquatic ecosystem. Even with strategically placed check valves where the pipeline crossed sensitive areas, such as major stream crossings, there would be some measure of impact that would be dependent upon such factors as volume flow and reaction time for repair and cleanup. The probable impacts from an accidental oil release into aquatic habitat have been discussed in detail in Section 3.1.8.2.2. The worst possible case of an unavoidable adverse impact would be an oil discharge into the lower Colorado River. Below the proposed crossing of the Colorado River are several ecologically sensitive areas such as the backwater lakes and the Cibola and Imperial national wildlife refuges. These could be devastated by an oil spill.

Major rivers encountered by the pipeline that would suffer unavoidable adverse impacts from an oil spill are the San Pedro and Gila rivers in Arizona, and the Rio Grande and the Pecos River in New Mexico. Other sensitive aquatic environments that would be unavoidably impacted by an oil spill include the San Gabriel River, San Jose Creek, San Timoteo Wash, the Palo Verde Valley water conveyance system in California, the Florence-Casa Grande irrigation canal flowing into Picacho Reservoir, and the playas within the Sulphur Springs and San Simon valleys in Arizona.

5.8.3 Rare, Threatened, Endangered or otherwise protected species

Sea Leg

Although tankering will take place in the Valdez-Prince William Sound area regardless of whether or not this project is implemented, all Rare, Threatened or Endangered species would be subject to impacts as discussed in section 3.1.8.3.

Marine mammals. Eight mammals and six birds classified as Endangered and one mammal classified as Threatened by the Federal Government could potentially be affected by oil pollution along the tanker route and in the ports of Valdez and Long Beach. All eight of the Endangered mammals on the Federal list are whales (finback, humpback, sei, sperm, blue, gray, right, and bowhead). The one Threatened mammal, the California sea otter, as discussed in Section 3.1.8.1.2, is the most vulnerable of all the marine mammals in the project area. An oil spill reaching a sea otter population would undoubtedly significantly reduce, if not eliminate it. Unlike the cetaceans and pinnipeds (other than the fur seals), oil would be fatal to the sea otter even if it coated only a small portion of the animal's body. However, as discussed in Section 3.1.5.1.2, the probabilities of oil spills reaching areas inhabited by the California sea otter would be remote because of the distances of the tankers from those coastal areas. The risk of secondary impacts (contaminated or reduced food supplies, for example) is much less, but is still a potentially serious impact. The island fox and Guadalupe fur seal, although not Federally classified, are considered Rare by the California Fish and Game Department. Whales would probably suffer the least damage of all marine mammals, although exposure to petroleum hydrocarbons could cause damage to the blowhole.

Marine and estuarine birds. Listed Federally Endangered species of birds that could be impacted along the marine route are the American peregrine falcon, short-tailed albatross, Aleutian Canada goose, California brown pelican, light-footed clapper rail, and California least tern. Additionally, the state of California has classified the Belding's Savannah sparrow as Endangered, and the California black rail as Rare.

Birds that occupy the bays and ports are in the greatest danger from an oil spill. The most critical Alaskan waters, therefore, are Port Valdez, Prince William Sound, Copper River delta, and Blything Sound. In California, these would include San Francisco Bay, Morro Bay, Monterey Bay, the coast from Point Conception to Long Beach, and the Channel Islands. Federally Endangered birds most commonly found in these waters include the Aleutian Canada goose, California brown pelican, light-footed clapper rail, and California least tern. The Belding's Savannah sparrow could also be encountered.

If large quantities of oil from a spill were to invade wetland habitat occupied by any of these birds, death to individuals could result from the loss of insulative value to oil-soaked feathers, ingestion of oil-covered food, and/or loss of nesting sites. Since these species are already limited in numbers, complete elimination of them in a specific oiled bay is possible. This is especially critical in the event of an oil spill because much of the oil is unavoidably lost to the environment with the best of clean-up equipment, and there is a period of exposure (time when birds are exposed to the oil) between the spill occurence and the time equipment arrives on the clean-up scene.

Pipeline route

Terrestrial and aquatic species. There are several species having either a Federal or state protective designation that could be impacted by new construction, regardless of any mitigating measures taken. However, since those species having a protected status generally have restricted populations or limited distributions, their chance of being encountered in areas of new construction is slight.

A reduction in the number of desert bighorn sheep is possible during the normal operation and maintenance of the pipeline, especially along the maintenance roads. In the Dome Rock Mountains, for example, the increased recreational use resulting from the existing maintenance road in this desert bighorn sheep habitat is almost certainly disrupting the normal activities of the resident sheep. The proposed power line would follow the existing maintenance road, thereby increasing the amount of maintenance activity in the area. These sheep are considered Threatened by the Arizona Game and Fish Department. By effectively removing a portion of their habitat from optimum use, a small reduction in this currently stable population could be expected as an unavoidable impact of the project.

An oil spill would be the worst possible unmitigable impact during the normal operational phase of the proposed project. An accidental oil spill could impact several protected species. In the Colorado River area, Federally Endangered birds known to inhabit the area below the crossing include the southern bald eagle, California brown pelican, American peregrine falcon, and Yuma clapper rail. The California yellow-billed cuckoo is considered Rare by the California Fish and Game Department. There are also two protected fishes which may be impacted in the Colorado River from an oil spill. These are the Colorado squawfish, on the Federal Endangered list, and the bonytail chub, on the California Rare list.

Protected fishes are also found in several other rivers crossed by the proposed project where an accidental oil spill could potentially reduce their numbers. The spikedace, considered Threatened by the Arizona and New Mexico Game and Fish Departments, and the Gila topminnow on the Federal Endangered list, could be impacted in the Gila River, as could the spikedace which is also found in the San Pedro River.

The proserpine shiner found in the Rio Grande and the Pecos River and the Pecos pupfish in the Pecos River are both classified as Endangered by New Mexico. Protected reptiles include the Texas slider, Pecos ribbon snake, and blotched water snake along the banks of the Pecos River. These species are considered Threatened by New Mexico. All of these could be impacted from an oil spill because of the inability to totally mitigate this kind of accident.

Also, an oil spill into the playas and marshes of Sulphur Springs Valley or San Simon Valley would destroy Mexican duck habitat. This is critical habitat for this Federally classified Endangered species.

5.9 CULTURAL RESOURCES

Even with full implementation of proposed mitigation, damage and destruction could occur to the paleontological, archaeological, and historical resources.

Damage would be almost certain to occur to sites not discovered in the preconstruction surveillance. In cases where excavations and/or collection mitigation is performed, the impact would still be negative in that not all possible data could be retrieved; once excavated, a site is effectively destroyed and removed from future direct research considerations. Salvage, even if channeled in scientific problem-resolving directions, is rarely as effective as nonsalvage research because of limited time, funding, and personnel levels. Emergency salvage, required by unexpected construction-related discovery, would be even less effective.

Some loss of historic integrity and interpretive potential would occur as a result of the intrusion of power-line extensions, pump stations, pipelines and roads into any site settings. Avoidance and protective measures during construction and maintenance of the lines would not reduce the threat of indirect impacts. These would result from utilization of the access roads by recreationists and other backcountry users, including workers, who might cause unintentional damage by driving off the access roads. Sanctions against construction and maintenance workers collecting and exploring for cultural or paleontological materials would probably not be fully effective.

The number, kinds, and significance of sites that would be affected and the severity of impacts to them are unknown.

Any cultural resources associated with bottom sediments in the proposed dredging area in the port would probably be lost. Should oil spill clean-up procedures not be effective in and around the port area, unavoidable aesthetic impacts could occur to several historic sites in the port area.

5.10 VISUAL RESOURCES

Mitigating measures proposed in Chapter 4, if implemented, would effectively eliminate most adverse visual impacts cited in Chapter 3. Exceptions are the following unavoidable adverse impacts which would persist until project abandonment and subsequent revegetation of disturbed sites and rights-of-way.

Southern California coast

Quarrying on Santa Catalina Island of rock for the breakwater would expand the existing quarry operation to a visually obvious extent, especially in terms of cut backslope reaching higher up the mountainous slope. Expansion of the quarry operation will require a California Coastal Commission permit. Based on stringent permit stipulations imposed by the Coastal Commission on analagous applications, some mitigation of this impact can be expected, although the California Coastal Commission has not committed itself to the mitigating measure in Section 4.3.2. During the short term while quarrying occurs and unless or until the quarry site was reclaimed, this quarry would be highly visible and constitute a significant unavoidable adverse visual impact for visitors at the resort and to boaters offshore.

Location of oil storage tankage within the California Coastal Zone violates the California Coastal Plan Guideline 56. The facilities on Pier J will require a permit from the California Coastal Commission. Based on stringent permit stipulations imposed by the Coastal Commission on analagous applications, some reduction of the number of storage tanks on Pier J can be expected, although the Coastal Commission has not committed itself to the mitigating measure in Section 4.3.2. Tanks on Pier J regardless of number would constitute a long-term adverse visual impact on coastal visual resources (see Section 3.1.10.1).

California desert

The applicant's commitment to tap the adjacent Southern California Edison transmission line at the Indio Pump Station, rather than to extend a power line to Coachella, would eliminate the adverse visual impacts of a new power line. The applicant's further commitment to landscaped berms and painting of facilities with harmonious desert colors, even though this facility is on private lands, would effectively reduce the adverse visual impact on

Interstate 10 and the Mecca Hills. However, the pump station still would be an obvious industrial intrusion on a scenic open-space area.

The power-line extension for the Desert Center Pump Station, despite the mitigating measures, still would cross Interstate 10, creating a visually dominant feature seen by motorists from approximately 4 miles of interstate highway. Approximately 15 square miles of open space would be visually dominated by the power line -- this portion of the desert receives considerable recreational use by residents of Desert Center, a retirement and mining employment center.

Arizona

Ehrenberg Pump Station and power-line extension

Relocation of the Ehrenberg Pump Station three-quarters of a mile east, coupled with the use of landscaped berms and painting of facilities with harmonious desert colors would effectively eliminate the adverse impact on the Interstate 10 roadside rest area and surrounding open-space area. However, the power-line extension required by this pump station would have significant adverse visual impacts on one of three areas, the Dome Rock Mountains, Interstate 10, or the Colorado River. The area impacted would depend on which alternative alignment is committed to after the environmental impacts of the various alternatives are detailed in a supplemental Environmental Analysis Report to be prepared by the BLM Yuma District.

Livingston Pump Station and power-line extension

The adverse impact of the power-line extension on the experience of Kofa Game Range visitors has not been eliminated as the power line still would cross the access road to the Kofa Game Range and a popular "snowbird" camping area.

Coolidge Pump Station and power-line extension

The applicant's commitment to eliminate the clearing of desert woodland vegetation would significantly reduce the visual impact. Nevertheless, there would still be a power-line crossing of the Pinal Pioneer Parkway (U.S. 80). The crossing would visually degrade approximately 4 miles of this scenic highway which receives moderate tourist traffic. The pump station and much of the power-line extension is well screened from U.S. 80 by desert woodland vegetation, but the facilities still would constitute an industrial intrusion on open-space values.

Black Mountain Pump Station and power-line extension

The applicant's revised plan to utilize ranch roads and pipeline corridor for the power-line extension alignment would reduce the visual impact by eliminating a new maintenance road with concomitant clearing of a right-of-way swath. Much of the power-line extension would not be detected by motorists, but the pump station still would constitute an obvious industrial intrusion on open-space values, especially if not painted colors that harmonize with the environment. The structure would impair approximately 16 square miles of open space.

Redington Pump Station and power-line extension

The applicant's commitment to eliminate the clearing of desert woodland vegetation within any power-line extension right-of-way and to avoid skylining would significantly reduce the visual impact. Nevertheless, the pump station and power-line extension would constitute a significant intrusion on open-space values of Soza Mesa. If the pump station were painted colors which did not harmonize with the environment, it would be highly visible to recreationists seeking a wilderness experience in the Galiuro Mountains Wilderness Area.

Cochise Pump Station and power-line extension

Reduction of the power-line extension from 30 miles to 8 miles by upgrading of an existing power line, as committed by the applicant, would reduce the visual impact on scenic and open-space areas from 124 square miles to 32 square miles. The power line would still be a visually dominant element in the foreground-middleground visibility zone as seen by Interstate 10 motorists from approximately 12 miles of highway (a reduction from approximately 35 miles by upgrading an existing power line rather than building a new power line in a new corridor). Location of the Cochise Pump Station within one-quarter mile of Interstate 10 in a rural open-space area would make the pump station a visually dominant industrial intrusion affecting approximately 4 miles of Interstate 10; this impact has not been mitigated.

New Mexico

Lordsburg Pump Station and power-line extension

The commitment not to permit any clearing of vegetation from the right-of-way and possibly to eliminate a maintenance road would significantly reduce the visual impact. Nevertheless the power-line extension through an open-space area would constitute a visual intrusion adversely impacting approximately 24 square miles of open space, even though it would be seen by relatively few people.

Anthony Pump Station and power-line extension

The adverse visual impacts of siting a visually dominant industrial intrusion in an agricultural/open-space area visible from Interstate 10, and a power-line extension crossing Interstate 10, cannot be mitigated because private lands are involved.

Pecos Pump Station and power-line extension

mile

The adverse visual impact of a 30-inch power-line extension on presently unencumbered open-space lands has been significantly reduced by eliminating the clearing of vegetation from the right-of-way and rerouting to avoid skylining. This lengthy power-line extension nevertheless would still be a significant intrusion on open-space values.

Texas

El Paso Pump Station and power-line extension

There has been no commitment to mitigate the adverse visual impacts (described in Section 3.1.10.3) of this pump station and power-line extension on Hueco Tanks State Park. Since only private lands are involved, only El Paso County could require the proposed mitigation described in Section 4.3. The pump station and power-line extension would be visible in the foreground-middleground zone from much of the park area and this intrusion on the park environs would degrade the park visitors experience. Hueco Tanks State Park has high natural, historical, and archaeological values.

Guadalupe Pump Station and power-line extension

The applicant is committed to a relocation of the power-line extension so as not to obstruct the outstanding view from U.S. 62/180 across the Salt Flats to the Guadalupe Mountains National Park. Although the most significant adverse impact has been eliminated, the 16-inch power-line extension still would represent a significant intrusion on open-space values and would be highly visible to U.S. 62/180 motorists.

5.11 NOISE

Noise impacts during pile driving in the harbor area would be unavoidable. Noise impacts during construction of pipeline segments cannot be mitigated and are, therefore, unavoidable. Sixty-five sensitive receptors (residences, parks, schools, etc.) were identified as likely to experience noise impacts (Table 3.1.11.2.1-1). Thirty-two receptors were estimated to experience less than severe impact (5 to 15 dBA increase in daytime noise levels); maximum duration would be about 11 days, with the average about 3.5 days. Thirty-three other receptors would experience severe noise impacts (at least 15 dBA increase in median daytime levels). The average duration would be about 2.5 days; the total duration of noise impact would average about 7.5 days. Residences near Whittier Narrows were estimated to experience severe impact for 8.5 days, with a total duration of 25 days. Other nearby receptors to the west (Rio Hondo area) would also experience considerable noise impact.

There would be noise impacts on the community hospital, the creative education center, and scattered residents from operation of the Redlands Pump Station.

5.12 LAND USES

5.12.1 Native American areas

The pipeline route through the native American areas, as described in Chapter 2, Section 12.1, should not result in any unavoidable adverse impacts or loss of utilization, since the existing pipeline now traverses these Indian reservation areas.

5.12.2 Scientific preserves and refuges

Cibola National Wildlife Refuge, which lies 20 miles downstream from the Colorado River crossing, and Imperial National Wildlife Refuge, 33 miles below the crossing, would suffer slightly from construction activities attendant to the crossing. These impacts, primarily from uncontained siltation and some discoloration of the stream, would degrade the aesthetic, recreational, and habitat values. If mitigating measures in Chapter 4 prove effective, the degree of unavoidable adverse impact should be minor. In the event of a major oil spill, the above refuges would be unavoidably adversely impacted as discussed in Chapters 3 and 4.

Construction impacts in the Kofa Game Range, as described in Chapter 3, would be largely unavoidable. The degree of impact would be determined by the successful implementation of the mitigating measures described in Chapter 4. The loss of an additional 90 acres of wildlife habitat, resulting from the widening of the existing pipeline right-of-way, is considered an unavoidable adverse impact.

5.12.3 Recreation and recreational values

Sea Leg

If there were a major oil spill in Prince William Sound, oil could reach many miles of shoreline. Present hunting and sport-fishing activities would be unavoidably impacted, as well as the aesthetics of the area.

Port of Long Beach

The tanker trestle and terminal breakwater would eliminate approximately 400 acres of water in San Pedro Bay presently used for sport boating and fishing. The popular shoreline sport-fishing area at the end of Pier J also would be eliminated. Construction of the breakwater and trestle would pose a navigational hazard among recreational boaters. Construction and operation of the terminal would permanently restrict an area heavily used by small-craft traffic. Within San Pedro Bay, the approximately 7,000 pleasure boats berthed there along with the additional capacity to launch approximately 1,000 pleasure boats per day would be affected by the reduction in water surface acreage, constriction of the bay, and increased tanker traffic hazards.

Off-loading of tankers would probably result in numerous small oil spills, approximately 20 percent of which would escape booming and cleanup. These small spills would be likely to wash ashore on the beaches of Long Beach, resulting in an incremental degradation of the beach environment. A major spill from a tanker accident likely would escape complete booming and cleanup. Washing ashore on the beaches of Long Beach, the major spill would result in degradation of the beach environment, possibly to the point of closure to public use until cleanup could be effected. Total cleanup of oil spills on water or those washed ashore is not practical or likely.

Los Angeles urbanized area

Pipeline construction would cause short-term adverse visual and recreation impacts. These impacts would be localized to the immediate pipeline corridor and limited to the construction period (less than three months). Conflicts with recreational trail use by bicyclists, equestrians, and hikers in the Los Angeles River/Rio Hondo flood control channels would be direct and might result in eliminating use of trails on a segmental basis during the construction period. Streamland Park, at the base of Whittier Narrows Dam, is being jointly developed by the U.S. Army Corps of Engineers and the city of Pico Rivera. The park could be severely disrupted by pipeline construction, depending upon the schedules for pipeline construction and park development (picnicking and swimming areas, court games, ball fields, etc.).

Colorado River

Construction of a submerged crossing of the Colorado River would directly conflict with recreational boating, fishing, water-skiing, and swimming in the Blythe area for the duration of the construction period. Turbidity from construction activity may visually degrade water quality downstream from the Blythe area as far as the Imperial Dam for the duration of construction, adversely affecting fishing and body-contact water sports, especially swimming. If this crossing should rupture, the resultant oil spill would likely travel downstream to Imperial Dam, degrading riparian vegetation, aquatic life, and sand beaches en route, and curtailing recreational use of the river until cleanup could be effected.

Pecos Pump Station power-line extension

The maintenance road which is expected to be required for the 30-mile power-line extension would open up new motorized recreational vehicle user opportunities. If motorized recreationists kept to the maintenance road this would be a beneficial, not an adverse, impact. However, based on past experience, some off-road recreational abuse of the natural environment is to be expected by facilitating access to this relatively undisturbed area.

5.12.4 Agriculture and grazing

Construction of the project would result in temporary removal of dry-farm and irrigated agricultural production on approximately 270 acres along the right-of-way in California. About 1,473 additional acres of open space used primarily for livestock or wildlife grazing would be similarly removed from production.

Cropland losses, either dry-farm or irrigated, would not last more than one year. Irrigated crops could be reseeded anytime after construction to coincide with the next crop cycle. Dry-farm crops (grains) could be seeded to take advantage of the succeeding growing period. In both cases, crop yields could be reduced for several years because of topsoil loss or soil profile mixing, despite careful preconstruction segregation. Loss of crops existing at the time of construction would be at a rate of approximately 6.7 acres per mile.

Livestock and wildlife-grazing use would be reduced by a range of 25 to 50 animal unit months by removal of livestock forage during construction. This loss of production of roughly 10 acres per mile would persist for several years at most locations because of slow regeneration of native desert vegetation.

Following construction, the permanent right-of-way would be reduced to a 40-foot-width for surveillance and maintenance. A total of 3,863 acres would be permanently removed from production along the route. This computation assumes that cropland through which the lines passes would be back in production and that the total loss would occur on the open space/grazing lands. Permanent loss to present grazing use would be at a rate of nearly 5 acres per mile or an average of one-sixth of the feed required to maintain a cow for one month in an arid or semiarid environment.

5.12.5 Minerals

No unavoidable adverse impacts are expected to affect the mineral resources because of this project.

5.12.6 Urbanized areas

Through the urbanized areas crossed by the pipeline, the short-term unavoidable adverse impacts would be those associated with the construction activities. These would include localized traffic congestion, noise, dust, etc., as described in Chapter 3.

Some oxidant, sulfur dioxide, and particulate impacts would occur in the Los Angeles Air Shed. The amount after mitigation is not expected to affect land uses. With full mitigation through trade-offs prior to approval to construct, there would be no adverse impacts. Some oxidant impact is expected at Midland, but it would have no adverse impact on land uses.

5.13 USE PLANS

5.13.1 Coastal and Sea Leg and Port

No unavoidable impacts have been identified on use plans for these areas.

5.13.2 Land

The placement of pump stations, utility lines, and maintenance yards on lands designated for agricultural or open-space uses, and therefore preempting these areas for the intended uses for the life of the project, is viewed as an unavoidable adverse impact.

5.13.3 Aquatic areas

The project is not anticipated to have any unavoidable adverse impacts on future-use plans for aquatic areas encountered along the route.

5.14 TRANSPORTATION NETWORK AREAS

5.14.1 Sea Leg

Unavoidable adverse impacts along the project's Sea Leg would be mainly from the increase of tanker traffic. This increase would last the life of the project and is discussed earlier in Ecological Interrelationships (Section 5.2), Vegetation (Section 5.7), and Wildlife (Section 5.8).

5.14.2 Port of Long Beach and terminal areas

Unavoidable impacts at the port facilities are primarily those caused by the disruption of commercial truck and rail traffic and would continue for the estimated 18-month-construction phase at Pier J. Breakwater and trestle construction would require surface vessels such as barges and dredges in the immediate area of the project. This would cause additional congestion inside the harbor which would continue throughout the construction period.

5.15 UTILITY NETWORKS

The major adverse impact related to utility networks would occur if, during the 18-month construction phase, an existing utility conduit (gas, electricity, telephone, etc.) were broken. This impact would occur first during construction or maintenance activities. The severity would depend upon the type of utility that was damaged and how long it remained out of service. Locations of occurrence are within the Los Angeles Basin to Redlands and Beaumont to Banning, California; Pecos River oil field collector lines; and Midland, Texas.

5.16 SOCIOECONOMIC CHARACTERISTICS

A major accident in Port Valdez or Long Beach Harbor could have moderate impact on economic values and human safety and welfare. The remoteness of Pier J could result in isolation of the impact from Long Beach. There would be a small probability that during the lifetime of the project an accident could result in severe damage to heavily populated areas. An accident that incapacitated the Long Beach terminal would require a sudden major effort to divert oil to other ports. An accident at the Long Beach terminal would probably result in a major disruption of normal traffic and emergency services in the harbor area.

The transportation of gas through El Paso's system, after the proposed natural gas pipeline abandonment, would require increased main-line fuel consumption as a result of increased compression in the smaller capacity system. The curtailments would range from about 8.74 billion cubic feet in the first year after abandonment to 5.19 billion cubic feet in the fourth year as natural gas supplies available for transport decline. By the 19th year after abandonment, natural gas curtailments would be less than 500 million cubic feet per year. Additional gas used for pumping during the first year after abandonment will be 1 percent of the total transmitted. As shown by the figures above, the percentage will decrease in future years. Approximately fifty percent of the curtailment would occur in the Los Angeles Air Shed.

An indirect impact of the loss of natural gas mentioned above is the subsequent use of oil as fuel to replace it. This use would result in lower air quality (on an annual decreasing basis) in the L.A. Air Shed (See Section 3.1.6.1.2).

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CHAPTER 6

SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

6.0 INTRODUCTION

The relationship between the short-term use of the environment for the proposed project and the long-term effects upon environmental productivity is addressed in this chapter. For purposes of this analysis, short-term is defined as 25 to 35 years (the projected economic life of the project), and long-term is defined as the period that follows the economic life of the project.

6.1 CUMULATIVE LONG-TERM IMPACTS PLUS IMPACTS OF ALL KNOWN ACTIONS WHICH COULD RESULT IN A CHANGE IN LONG-TERM PRODUCTIVITY

Within the time frame of the estimated economic life of this project, construction activities would preempt lands and waters of short, intermittent pipeline segments from agricultural, mineral extraction, recreational, rangeland, and wildlife habitat uses. Following the pipeline and ancillary facility installation, the operational phase would allow the majority of the construction corridor to begin to revert to its preconstruction use. Operational use of the environment involves port facilities, storage tanks, the 18 pump stations, pipeline maintenance roads, power transmission line roads, microwave communication facilities, and the transport of crude oil to energy deficient regions of the United States. Following the end of the project, it is expected that most of the above-ground pipeline facilities would be converted to other uses or removed. Port facilities are expected to remain in use beyond the life of this project.

6.1.1 Sea Leg

Degradation of air quality resulting from air pollution emissions at Valdez would span the life of the project. Emissions from normal operations would result in elevated oxidant and sulfur oxides levels. A spill in the Port area would affect air and water quality. Marine environments along the tanker route would not be enhanced and, even with the best of mitigating procedures, would be adversely affected by oil spill occurrence. Short-term losses would include the reduction in biological productivity of areas subject to accidental discharges of oil from accidental operational spills. Spills could result in mortality of plankton, nekton, benthos, fish, birds, and mammals. Both catastrophic and operational spills would result in changes in marine habitats, reductions in populations of plankton, nekton, fish, benthos, birds, and mammals, and modifications of the food web.

After the project, oil spills and their impacts would not occur and the ocean environment is generally expected to remain or return to preproject productivity levels. However, it is suspected that there could also be adverse impacts on long-term productivity over the entire marine and coastal ecosystems as a result of previous accidental discharges of oil at various points along the route. Such effects might include reproductive impairment, increased probability of predation, or reduced probability of settling on a suitable substrate required for recruitment into the adult population. Many marine organisms are known to have petrochemicals in their flesh when sampled near an oil source, such as refineries or a natural seep. The effects of this accumulation on the physiology and behavior of affected individuals is unknown, other than that humans may sense an "oily" taste when consuming them. Most organisms, though, seem to be able to purge themselves of oil when placed in clean running seawater. Additional research on the potential long range and accumulative sublethal effects of hydrocarbons, however, is required before conclusions can be drawn.

Port of Long Beach (harbor area)

The proposed action would increase the likelihood of incremental and catastrophic project-related oil spills which in turn will threaten future productivity. In time, higher fractions of the oil would evaporate and a portion of the heavier oil would sink and become incorporated into the bottom sediments, creating thick films or heavy deposits of oily residue on the bottom. These deposits would be acted upon by oxidizing or reducing mechanisms, depending on the available oxygen content throughout the impacted area. If the interstitial waters or sediments become oxygen deficient, the rates of biodegradation would be markedly lower, reducing the long-term productivity of a once-abundant marine ecosystem.

Project construction elements such as the breakwater and trestle would offer new habitat and enhance productivity for the colonization of rocky shore species, piling organisms, and associated fish and birds. However, installation of the permanent breakwater will result in a long-term loss of 5.9 acres of surface water in the harbor.

6.1.2 Port of Long Beach and terminal (land area)

Air quality

Los Angeles area. Minor short-term degradation of air quality near construction would be expected. Adverse impacts on air quality would span only the life of the project. During operation, adverse impacts on air quality would vary with meteorological conditions and tanker off-loading events. Any spill exceeding 200 barrels in the Port could also cause a short-term loss of air quality. A major spill would probably not occur in the Port during the lifetime of the project. If it did, the impacts upon air quality would be severe under almost any meteorological conditions but of short-term duration.

Noise

Los Angeles area. Noticeable noise levels would be experienced by sensitive receptors during construction. In the area adjacent to pipeline construction, the noise would usually last a few days. At some locations between Pier J and Walnut, a moderate construction noise impact would persist for up to 25 days and severe noise impact for up to 8 days. There would be occasional and perhaps objectionable noise resulting from maintenance activities near pump stations. No impacts on long-term productivity are predicted.

6.1.3 Pipeline route

Air quality

No significant short-term or long-term productivity impacts on air quality would be expected after completion of construction. During the construction of the new pipeline sections the following would occur: (1) fugitive dust and nitrogen oxide emissions (NOx) would cause minor impacts; (2) visibility might be affected during gusts and high wind; and (3) dust and NOx might on occasion lower the performance of workers. The utilization of the existing natural gas pipeline would reduce short-term air quality impacts resulting from all new construction. A major spill along the pipeline would have severe impact on air quality under severe meteorological conditions; this event has a low probability of occurrence during the life of the project.

Noise

Small short-term noise impacts would be expected upon people living near major highways through which pipe and other supplies might transit to the construction sites. During the life of the project, noise would be noticeable near the Redlands Pump Station from operation and occasional maintenance activities.

Geology

The long-term loss of geologic resources that would be unavailable for extraction and consumption during the life of the project are those that directly underlie and support the right-of-way; e.g., the sand and gravel deposits at the Santa Ana River floodplain. The quantity of material that would be lost is negligible in terms of the total of each resource located adjacent to the route. Nevertheless, in terms of certain individual deposits, the quantity would be large. In terms of some specific operators' resources, the loss might also be great. Remuneration by the applicant for the quantities lost probably would be required by present owners.

The geologic resources most directly affected by the construction and operation of the proposed pipeline would be those that are normally extracted by stripping, pitting or quarrying, and which would be traversed by the proposed route. These resources consist mainly of sand, gravel, and crushed rock along the Santa Ana River. Future demands in the resources market might add clay and shale, industrial sands, and colored cinder rock.

Those geologic resources situated at depth beneath the right-of-way probably would not be affected. Water, petroleum, and natural gas, for example, are found at considerable depth and can be extracted by wells whose surface operations may be remotely located from the right-of-way area.

Soil

Short-term soil movement would be undetectable from that of normal geologic erosion if the year of construction were meteorologically normal and the resultant average annual runoffs were in the range of 0.1 to 0.5 inch for 99 percent of the construction route.

Crop yield in the two to three years following construction would be reduced by an indeterminate amount because of the variables of indiscriminate soil profile mixing and rooting depths and growth habits of individual crops.

Long-term loss of soil fertility and productivity would be evident on the open-space lands as a result of soil profile mixing during construction and continued compaction on the maintenance road during operation. Soil losses due to wind during construction, as cited in Chapter 3, might be assumed to be permanent.

Water

Measurable short-term losses would be in terms of water quality degradation resulting from new pipeline burial at the following crossings: San Gabriel River, Santa Ana River, San Timoteo Wash, and the Colorado River.

Water quality suspended sediment and turbidity standards of the states of California and Arizona would be exceeded temporarily. Rates would exceed background levels for periods of several days at the San Gabriel, Santa Ana and San Timoteo locations, and an estimated 18 days at the Colorado River. Final impacts of added sediment would be temporary on aquatic flora and fauna associations and communities by briefly slowing photosynthesis and lowering oxygen levels in the water.

In the event of major oil spills or undetected small leaks into surface or groundwaters, use of these waters for industrial, domestic, recreational or other purposes would be forfeited for days or months, depending upon the magnitude of the spill. Resulting impacts would affect industry, agriculture, water-based recreation, and domestic supplies where diversions are used for these purposes.

Short-term permanent losses of water would be an estimated 200 acre-feet to be used in dust abatement as described in Chapter 3 (3.1.1 and 3.2.1) and smaller undetermined amounts due to hydrostatic testing. These amounts would be lost primarily through evaporation. In general, the impacts on and loss of water resources are expected to result in no losses in long-term productivity. However, should a major spill occur in a stream or river or a major undetected leak result in groundwater contamination, the productivity of water related biologic communities or domestic water supplies could be adversely altered for many years following such a spill.

Vegetation

The effect of this project upon the long-term productivity of the natural vegetation is closely related to the average annual precipitation in the biomes crossed by the proposed pipeline.

California Coastal Biome. In the California grassland, which receives 10 to 20 inches of annual rainfall, there would be a short-term loss in productivity in the area not affected by soil profile mixing. The first year of vegetation would be predominantly leafy annual forbs; the annual grasses would make up only about 15 percent of the vegetation cover. There would be no significant forage for grazing the first two years after construction. Intermediate succession would result in a greater composition percentage of grass species with a limited amount of forage. In the fourth or fifth year, productivity should approach that of the adjacent undisturbed area. The loss of annual grass productivity would be for at least a 10-year period but probably would not be long-term as a result of loss in plant density and vigor where soil profile mixing occurs (Don Hines, BLM, Riverside, Calif., 1976: tele. comm.).

Colorado Desert and Yuman Desert biomes. Within these biomes, the impact of this project upon the vegetative productivity would be long-term. Studies conducted in the Mojave Desert on the creosote bush scrub vegetation have addressed the problems of revegetation following pipeline construction and the effect that power transmission lines have on desert plants. Rainfall within this area averages 5 inches or less per year.

Following pipeline construction, time required for the plant cover to regain preconstruction conditions, as related to composition and ground cover, is difficult to predict. The highest comparable revegetation rates reported by Johnson (1975) were in areas of high productivity consisting of good growing conditions in terms of rainfall amount and regularity, soil quality, and an intermediate-age plant community. After 12 years, significant revegetation had occurred. Areas of low productivity that consisted of poor growing conditions in terms of very low precipitation with poor, rocky soil failed to demonstrate significant revegetation progress. Thirty to 40 years is considered too optimistic for vegetation recovery, and it has been estimated the recovery potential may be measured in centuries to achieve the preconstruction condition. Soil conditions along the pipeline after construction can be drastically different from those before construction (Johnson, 1975). Productivity at the pump stations would be lost for the life of the project.

Following power transmission line construction, there would be a number of long-term impacts upon vegetation productivity. Included would be permanent devegetation of the maintenance road, a slight increase in plant cover under the central wire, and a somewhat greater vegetation enhancement along the road edge (Vasek, Johnson, Brum, 1975; and Johnson, Vasek and Yonkers, 1975). Immediately beneath each power pylon, there was drastic disturbance from construction. After 33 years, the quality of the recovering vegetation approached that of the adjacent undisturbed vegetation, although the effects of disturbance were still detectable.

Desert Grassland Biome to Jal, New Mexico. In this region the pipeline would cross predominantly semidesert shrub-grass ranges which receive an annual precipitation of 8 to 14 inches a year (Martin, 1975). Included in this area are the Oracle and Bowie natural gas compressor stations which would be removed and the sites then allowed to undergo natural revegetation. With increased precipitation, vegetation recovery time should be less than in the Mojave Desert. Martin states that in areas where mesquite has been removed, grass response has been excellent where there is a combination of 8 inches or more of summer rainfall and a good remnant of perennial grass. Where the grass cover has been totally eliminated, recovery is a slow process. In a study by Garner (1950), a grass site that had been dominated by tobosa grass was plowed and planted to crops and subsequently protected from grazing for 32 years. The site had not returned to the original tobosa grass climax. Also, the newly established grasses had a cover percentage of only a little over one-half that of an undisturbed climax tobosa grass site. This site, located near Silver City, New Mexico, received 17 inches of annual rainfall and did not experience soil profile mixing. Not only is revegetation slow, the invading pioneer community may have a completely different composition, with lower productivity. Both of the latter conditions may persist indefinitely. Interestingly, Martin (1975) points out that ranges moderately grazed recover faster than ranges under complete protection. Revegetation by seeding is unreliable when annual precipitation is less than 12 or 13 inches.

Short-Grass Prairie Biome. The Short-Grass Prairie Biome from Jal to Midland is a natural grassland climax which presently is in a series of successional stages (Wyatt Lipscomb, 1976: pers. comm.). Generally, natural revegetation of the perennial grasses to their preconstruction productivity takes from 5 to 10 years (James Crumley, Odessa [Texas] SCS, 1976: tele. comm.). Revegetation time is heavily dependent upon reliable annual rainfall (which averages between 11 and 15 inches per year), soil quality, richness of the grass communities adjacent to the pipeline, and remnant perennial grasses within the construction zone. Revegetation by seeding shortens the successional stages and returns the rangelands to preconstructon productivity within two to three years on the sandy areas if there is favorable rainfall and protection from grazing. Rocky areas have had fair success where some soil was left from backfilling.

Endangered and Threatened plants. These species will be identified by a field survey prior to construction. Any reduction in habitat or population would represent a loss in long-term productivity and diversity to the plant communities and could result in loss of a species.

Wildlife

In the short-term, certain species would be adversely affected locally, but the probability of the overall long-range productivity of any population along the pipeline route being affected is very small. The only exception would be the extremely unlikely chance of an entire species being eliminated. Although impacts to Threatened or Endangered species are not anticipated, any reduction in habitat and population would represent a loss in both short-term and long-term productivity and diversity of the ecosystem. Most of the pipeline route is existing natural gas pipeline, and therefore Threatened or Endangered species should not be affected in these stretches.

The most obvious short-term impacts from the proposed project would be from an accidental oil spill. If an oil spill were to occur in one of the major rivers crossed by the pipeline, the impact to the aquatic ecosystem might be evident for at least 5 years.

Long-term loss of habitat would occur from the construction of 130 acres of pump stations and 151 acres of power-line maintenance roads. In California, there would be little impact on big game populations as most of the new construction would be in areas where man's endeavors predominate. The most significant impacts on long-range productivity would be on small game, birds, reptiles, and amphibians within the immediate construction corridor. In the Kofa Game Range, new construction right-of-ways would remove approximately 73 acres of marginal bighorn sheep and deer habitat. As a result, no short-term or long-term declines in sheep or deer populations would be likely.

The wildlife populations along the new right-of-way from Jal, New Mexico, to Midland, Texas, are limited both in diversity and numbers. Therefore, the likelihood of encountering and adversely affecting wildlife in this area is much less than in other areas where new construction is proposed.

As human activity increases along the right-of-way during and after construction, vegetation would be suppressed and the plant composition would be composed of many invader species undesirable to resident wildlife populations. Wildlife would also experience increased harassment from man at the pump stations causing animals to vacate favorable habitat with a cumulative effect on surrounding habitat. With reduced habitat productivity, wildlife numbers would also suffer reductions. This loss of productivity is expected to continue for several to many years after the project depending upon the specific location.

Visual resources

Construction activity in desert areas represents a long-term visual impact as cleared areas and lighter-colored subsoils are visually evident until revegetation, weathering, and erosion processes restore the landscape's natural character adjacent to the maintenance roads and pump stations. Pump stations, pipeline and power-line maintenance roads, power lines, exposed pipeline crossings of rivers and drainage courses, valves, and passive repeaters constitute long-term visual impacts. These long-term impacts would be mitigated by pump station relocation, painting, and landscaping techniques where feasible. Impacts detailed in Chapter 5 would persist for the life of the project. After project abandonment, scars would be evident at pump station sites, maintenance roads, and the Santa Catalina Island quarry.

Recreation resources

Construction activity which would interfere with or disrupt recreation resources identified in Chapter 3 would be largely short-term adverse impacts. Long-term adverse impacts would be possible from accidental oil spills, especially on beaches of southern California, and at the Colorado River. Pipeline and power-line access roads would provide additional access for motorized recreationists. These roads would expose some open-space areas to increased use and consequently some possible long-term loss of productivity resulting from adverse impacts on soil, vegetation, and wildlife habitats.

6.2 ANY OPTIONS WHICH WOULD BE FORECLOSED FOR FUTURE USES OF MAN'S ENVIRONMENT

6.2.1 Sea Leg

It appears that no long-term future uses of the marine environment along the tanker route would be significantly foreclosed. However, future commercial fishing or crab harvesting in Prince William Sound or kelp harvesting in southern California could conceivably be affected by oil spills resulting from the proposed project or other transportation of North Slope oil.

6.2.2 Port of Long Beach and terminal area

The white croaker is one of the most dominant fish found in the harbor complex. The potential commercial utilization of this resource could be reduced or possibly foreclosed by project-related incremental and catastrophic oil spills that cause tainting of fish flesh. There are other species of fish in the harbor, such as queenfish, that are also not considered prime commercial species, and their potential utilization could possibly be affected in a similar manner.

The northern anchovy is sought for commercial and bait purposes and, consequently, its presence is exceptionally important in the Los Angeles-Long Beach harbor complex. The harbor is an important nursery area for the anchovy, the density of juveniles in the harbor often exceeding the density of inshore areas to the north and south. This nursery function of the harbor is immensely important to the fishing industry. This resource could be reduced or possibly foreclosed by project related environmental changes due to construction and oil spills. Also, the dredged channel area could not be fished as intensively because of the shipping traffic.

6.2.3 Pipeline route

No options have been identified which would be foreclosed to future uses except as noted in the foregoing sections due to long-term commitment of resources.

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CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

7.0 INTRODUCTION

This chapter describes the irreversible and irretrievable commitments of both renewable and nonrenewable resources involved in the construction and operation of the project. Additionally, it is concerned with those which potentially would be jeopardized by an oil spill from the project. Energy utilization is considered elsewhere (Section 7.2).

Irreversible commitments of resources to the project result from actions that cannot be reversed once the project is initiated. The resources are committed or jeopardized for the life of the project, and revocation of permits, cessation of operations, or removal of structures is unlikely. Irretrievable commitments of resources to the project involve those resources which are consumed, destroyed, or degraded during construction and/or operation of the project, including losses due to oil spills through accidents or natural catastrophes.

Although irreversible and irretrievable resource commitments are identified for the Prince William Sound area, similar commitments would occur in this area without this project in the transportation of North Slope crude oil from the Valdez terminal.

Summary of irreversible and irretrievable commitments of resources

Irretrievable commitments of biological resources would be limited to those individuals of plant and animal species lost during construction of the project or from chronic or accidental contamination from oil spill in the marine, terrestrial, and freshwater environments. These could occur particularly in Prince William Sound, and the Port of Long Beach or San Pedro Bay, or at sensitive water crossings such as the Colorado River.

Visual intrusion and land-use commitments associated with construction of the project including its related ancillary facilities would constitute irreversible resource commitments for the life of the project. Any cultural resources which may exist in the construction area and are not identified and recovered prior to or during construction would be irretrievably lost or destroyed.

Mineral needs for construction of pipe and tankers will irreversibly commit unknown quantities of steel, and irretrievably commit unknown quantities of sand, gravel, cement, asphalt, and water. Upon abandonment of the project, the steel could be salvaged.

Energy utilization would require the irretrievable commitment of an estimated 6.375 billion barrels of crude oil (amount withdrawn from North Slope resource store) based on the applicant's projected rate of delivery of 700,000 bbl/d to Long Beach for the life of the project. From an energy balance standpoint, 1.27 percent of the total Btus delivered to Midland, Texas, would be irretrievably consumed as a result of fuel used for transportation from Valdez, Alaska. Commitment of tankering fuel, it should be noted, will occur to some degree regardless of whether or not the SOHIO project is implemented because oil will be flowing from the Trans-Alaska pipeline.

7.1 COMMITMENT OF RESOURCES

7.1.1 Sea Leg

Northern portion. Certain fisheries, bird, and mammal resources would be irretrievably lost for the life of the project if they are eliminated or reduced by chronic or accidental oil spills or other pollution. Specific fisheries which would be markedly reduced include: (1) herring-eggs-on-kelp in Prince William Sound; (2) pink salmon and chum salmon in Port Valdez and Prince William Sound; (3) Dungeness crab, king crab and Tanner crab in Prince William Sound, the northern Gulf of Alaska. Most of the irretrievable losses of marine mammal populations, including fur seals and sea otters, would occur in Prince William Sound and along the southern California coast (see Chapter 3).

Significant percentages of the eelgrass communities, principally in the northern Gulf of Alaska and Prince William Sound and to a lesser degree along the southern California coast, would be destroyed and lost for periods of from several to more than 10 years. After the life of the project, and later when there is no more crude oil flowing from any North Slope source, these populations may return to normal levels, barring any adverse effects upon them from other future projects.

Tanker fleet

Construction of four 165,000 DWT tankers to complete SOHIO's tanker fleet would irreversibly commit steel and other materials utilized for the life of the project. New and existing tankers could be converted to other uses, and steel and other metals salvaged upon project abandonment.

7.1.2 Port of Long Beach and inland terminal

The destruction of any marine life during construction and operation activities would cause irretrievable losses; the specific organisms that would be destroyed constitute a resource loss which could not be restored.

There is no maintenance dredging anticipated for the proposed 79-acre dredge area. A climax benthic community would eventually be reached at the dredge site, but whether it would be identical to its former composition would depend upon such conditions as bottom circulation, sediment distribution, and buildup of pollutants. The difference between the predredged benthic community and the climax community attained after dredging would be an irretrievable loss. The expansion of Pier J would produce an irreversible conversion of the marine environment to a man-made landfill and would result in permanent loss of recreational fishing and boating areas.

The breakwater and trestle pilings would permanently displace about 22 acres of relatively high species-diversity benthic habitat; this would constitute an irreversible commitment of habitat. The breakwater, while irretrievably destroying benthic organisms, would be likely to create a rock fish habitat.

The breakwater would irretrievably commit quarry waste rock, armor rock, and contained dredge material. The planned source for the rock is the Santa Catalina Island rock quarries. An estimated 2.6 million tons of material would be required as follows: (1) quarry rock, 1,250,000 tons; (2) armor rock, 200,000 tons; and (3) dredge fill, 700,000 cubic yards.

Inland terminal

The materials used to construct the eight steel storage tanks and the space occupied by the tank farm would be irreversibly committed for the life of the project. Upon abandonment of the project the tank farm could be converted to another use or the materials salvaged and the site used for some other industrial land use.

Air quality, Los Angeles Basin

In the absence of adequate trade-offs, air quality and visibility would be irretrievably reduced during the life of the project. This change is not irreversible; however, relative loss of air quality during the project life would be irretrievable, particularly in areas inland to the north and east of project facilities in Los Angeles County.

7.1.3 Pipeline route

Land use

The pipeline rights-of-way, pump station sites, and power-line rights-of-way represent irreversible land use commitments for the life of the project. Given the increasing environmental difficulty of routing utilities, it is more likely that the corridor for the pipeline, if the line were abondoned, would be converted to another utility corridor rather than being permitted to revert to a natural environment. Proposals presently exist that would place major overhead transmission lines parallel to portions of the pipeline corridor, and major portions of the SOHIO pipeline proposal involve conversion of natural gas pipelines. Thus, the corridor for the long term would be likely to remain.

Oil-spill hazard

The pipeline constitutes an oil-spill hazard for environments traversed and downstream from it. In the event of an accident or natural catastrophe, a pipeline rupture could produce irretrievable loss of soils, vegetation, wildlife, and recreation opportunities. Water quality will be irretrievably degraded until the oil spill is completely cleaned up. Based on national pipeline statistics, the probability of a major oil spill during the life of the project is unlikely (less than one occurrence during the life of the project). Environmentally sensitive and hazardous areas such as river crossings, fault zones, subsidence areas, flood-prone and gully areas have been protected by design of block and check valves to minimize the size of any potential oil spill, and an oil spill contingency plan has been prepared.

Visual resources

The pipeline's proposed aboveground facilities and sites, especially power lines, pump stations, valves, maintenance roads, which involve linear clearing of desert vegetation and linear obliteration of desert pavement areas, would constitute an irreversible commitment through degradation of visual resources within the pipeline's visual corridor for at least the life of the project.

Recreation resources

The pipeline and power-line maintenance roads would cause irreversible changes in the character and intensity of recreation use by facilitating recreational vehicle use and abuse and increased human activity, resulting in an irretrievable commitment of primitive and natural values.

Vegetation and wildlife

Construction, operation and maintenance of pipeline, pump stations, and power lines would cause irretrievable loss of individual plants and animals. The loss of individuals of unique, sensitive or Endangered species could represent the irretrievable loss of the species as well. The likelihood of the loss of an entire population of a species as a result of the project, however, is remote.

Most plant and animal species found along the route are fairly common, and most of the animals are highly mobile or live outside of the route. Both wildlife and vegetation species are renewable resources; however, revegetation of the pump stations and major portions of the permanent pipeline and power-line corridors in desert environments is not likely. Maintenance roads, maintenance activities, mixing of the soil profile, and recreational vehicle abuse would effectively keep native species from returning to the composition, height, and density of the surrounding environment.

Soils

The new pipeline and power-line maintenance roads and pump station sites represent an irretrievable loss of soil productivity for the life of the project and for an undetermined length of time thereafter. Mixing of the soil profile in desert areas would retard natural revegetation within the construction right-of-way. A temporary reduction of soil productivity could be anticipated for several years where new pipeline construction crossed agricultural areas, despite double-trenching techniques.

Cultural resources

As discussed in Section 5.9, the cultural resources that would be unavoidably impacted represent an irretrievable commitment of resources. Any remnants or artifacts encountered, once damaged or destroyed, could not be retrieved and could reduce the opportunity to gain further knowledge of man's past.

Materials

The pipeline would commit approximately 236 miles of new steel pipe, ranging in diameter from 30 inches to 48 inches, one 80,000-barrel steel service tank, one 10,000-barrel steel service tank, and miscellaneous steel support equipment. The steel in some of these items is reclaimable upon the termination of the project. Other natural resources committed to the construction and conversion of the project will be irretrievably lost, including unknown quantities of sand, gravel, cement, asphalt, and water.

7.1.4 Midland terminal

Four 500,000-barrel steel tanks constructed at the terminal represent an irreversible commitment for the life of the project, but could be converted to other uses or salvaged upon project abandonment. The land used for the terminal would be irreversibly committed for the life of the project.

7.2 ENERGY UTILIZATION

The SOHIO tanker fleet, in transporting 700,000 barrels of oil per day to Long Beach and then unloading, would consume 9,500 barrels of fuel oil per day, or 87 million barrels over the 25-year life of the project. In terms of energy efficiency, 1.4 percent of the total Btus transported by tanker from Valdez to Long Beach would be consumed in transit, or in other words, one barrel of bunker fuel would be consumed for every 87 barrels of crude transported.

The pipeline from Long Beach to Midland, Texas, would transport 500,000 barrels of oil per day or 4.5 billion barrels over the life of the project. Eighteen pump stations with a total horsepower of 156,000, requiring 116 megawatts of power, would be required to pump the oil, or a total of 25 billion kilowat-hours for the 25-year period. In terms of energy efficiency, the pipeline transportation system would consume 0.57 percent of the Btus transported from Long Beach to Midland.

Looking at the overall energy efficiency of the project from Valdez via Long Beach to Midland, the proposal would consume about 2 percent of the Btus transported, an irretrievable commitment of energy.

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